CalComp Model 921
Solid-State Memory Controller
Maintenance

technical manual

Part No. 10206-901-002-2

MODEL 921 SOLID-STATE MEMORY CONTROLLER

MAINTENANCE MANUAL

March 1980

CALCOMP
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REVISION	NOTES
-2	Change Part Number from 10206-901-912- to 10206-901-002-2; changed title to delete Vol. I reference; added IPB; incorporated Tech Bulletin GC066B re Loader Module information; deleted Figure 1-8; included additional information on use of the Static Clock.

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SECTION 1

SYSTEM INFORMATION

Section 1
SYSTEM INFORMATION

This manual contains installation and maintenance information for the Model 921 Solid-State Memory (SSM) Controller. The controller includes a central processing unit (CPU) and an 8K memory (memory information is for reference only because the memory is a replaceable unit). Details for maintenance of the magnetic tape unit (MTU) are in a separate manual, P/N 10075-901-012. The CPU is connected to peripheral devices through interface modules. Table 1-1 is a list of devices, including the MTU, which can be connected to the controller.

Note

Interface modules must have been built or modified to the correct revision level to be used with the SSM controller. Consult the Technical Support Specialist for correct revision level numbers.

TABLE 1-1. PERIPHERAL DEVICES

Peripheral	I/O Module	I/O Part Number
936 Plotter	P1	20258-801-000
500 Series Plotters, 836 Plotter	P4	20282-801-000
960 Plotter	P14L	20219-801-111
7-Track MTU*	P29	20154-801-000
7/9 Track MTU*	P29	20155-801-000
1600 Bpi MTU*	P29	20159-801-000
9-Track MTU*	P29	20231-801-000

*One of these required

INSTALLATION PROCEDURES

Inspection

- Inspect the shipping container; if there are signs of damage, note this on the Installation Report Form.
- Check the packing list to verify that the required type of controller and accessories were delivered.

Unpacking

- Move the equipment to its final destination. Be sure that there is enough room for unpacking.
- Remove the top and sides of the shipping container, and check that the controller is not damaged.

Note

When removing the top and sides, flatten any protruding nails. This will prevent accidents as well as cabinet scratches.

- If a shipping skid is used, remove the bolts that hold it to the controller.
- Place the controller in its final location, and remove all protective packing material.
- Install the leveling pads (packed with the loose equipment: leveling pad P/N 14273-204 and square head setscrew P/N 60077-206-421), one at each corner of the controller.

Pre-Operational Checkout

Inspection:

- Check that no packing material remains between the CPU, I/O, or memory printed-circuit boards.
- Inspect cable connectors and all visible hardware; tighten them if necessary.
- Check that there is clearance for ventilation between the back of the controller and the wall.
- Check that the fans are not obstructed by packing material.

Cabling:

- Uncoil the power and signal cables inside the controller and pull them through the opening in the bottom of the cabinet. Do not connect them at this time.
- Inspect the power supply label and verify that the voltage rating agrees with the source voltage rating.

- Set the POWER ON toggle switch on the operator control panel to the off position.
- Set the AC POWER switch on the Power Adapter (accessible from hole on the outside of unit) to the off position.
- Connect the power cable to the power source outlet; be sure that the cable routing will meet with FSE and customer approval.
- Set AC POWER switch to the on position.

Note

Do not turn on the controller power.

- Check the voltage between the controller and any equipment nearby that the operator may touch. If there is any voltage difference, disconnect the power cable. Notify the customer that the outlet of the power source is possibly miswired.
- If there is no voltage difference, set the POWER ON switch on, and repeat the above checks.
- If there is no voltage difference, check the power supply for correct voltage output.
- Turn off controller power and connect the I/O cable to the peripheral device.
- Turn on controller power and again check the power supply voltages. If the voltage readings are correct, run the Graphic Control Software (GCS) or Maintenance Software Tests described below. Turn off the power.
- Lower the leveling pads to stabilize the controller.
- Remove any remaining protective packing material, and clean the equipment with a mild detergent.

MAINTENANCE SOFTWARE

Maintenance software includes diagnostic and confidence test programs. Diagnostic programs check particular functions to isolate a fault when the system fails; confidence test programs check the operational capability of the controller with a peripheral device. Procedures for initializing and running test programs are in maintenance software document P/N 10206-901-017. A listing of the diagnostic test program is in this maintenance manual. Diagnostic and confidence test tape part numbers follow:

921 Diagnostics (7 Trk, 800 BPI)..... 10275-902-000
921 Diagnostics (9 Trk, 800 BPI)..... 10276-902-000
921 Diagnostics (9 Trk, 1600 BPI)..... 10277-902-000
7-Track, 800 BPI Confidence/Data... 10020-902-001-1
9-Track, 800 BPI Confidence/Data... 10020-902-002-1
9-Track, 1600 BPI Confidence/Data.. 10059-902-001-1

ADJUSTMENTS

Adjustments are specified in the section that identifies the components to be adjusted. Refer to the Power Supply section for power supply adjustments, and to the MTU manual for tape unit adjustments.

CABLING

Figure 1-1 shows the interconnecting cables within the controller. Except for the channel 7 I/O module, which is always the first in a chain of up to seven modules, a module can be in any channel position in the chain. The channel number is the address of the module.

PREVENTIVE MAINTENANCE

Preventive maintenance checks avert failures and prolong the useful life of the controller. Such checks should be performed periodically and on each service call. The optimum interval between the maintenance checks depends mainly on the operating conditions and usage. In general, servicing every 3 months should suffice. Note that all moving parts are permanently lubricated at the factory and should not be lubricated in the field.

Visual Inspection

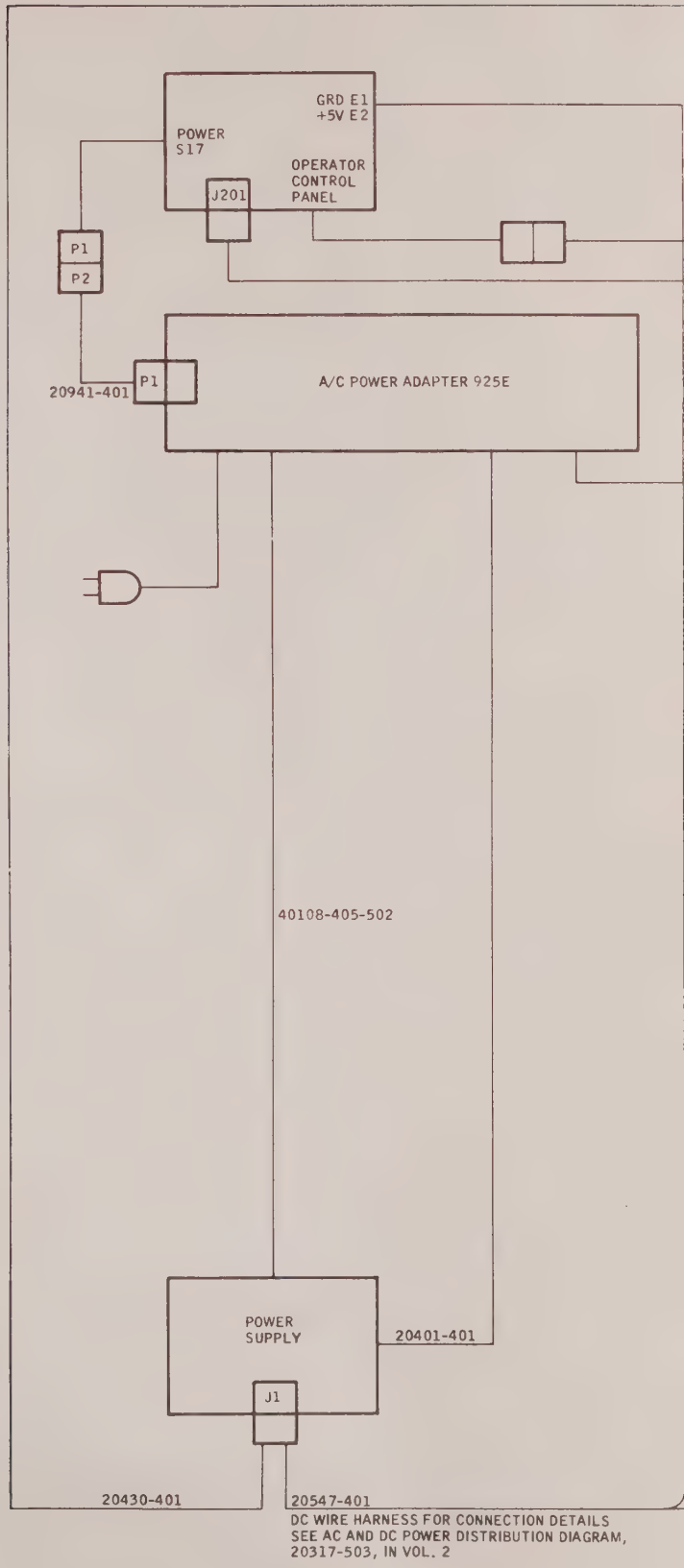
1. Inspect all hardware and cable connectors that are visible inside the controller; tighten them if necessary.
2. Ensure that CPU, I/O, and memory printed-circuit boards are seated properly.
3. Lift the MTU window and check the surface of the read head for uneven wear caused by tape movement.
4. Remove both tape reels; check the surface of the tape deck for signs of scraping caused by the rotating tape reels.
5. Ensure that the tape arms have normal movement for their full length of travel.

Adjustments

As mentioned earlier, refer to the Power Supply, CPU, or MTU section for the specific adjustment instructions. Always check the power supply voltages before performing any checks or adjustments in the other parts of the controller.

Cleaning

Because only the MTU contains moving parts, the cleaning procedures apply mostly to this unit. The cleaning consists of removing the oxide coating from the parts in contact with the moving tape. If the oxide


GRD E1
+5V E2
POWER
S17
OPERATOR
CONTROL
PANEL
J201
P1
P2
20941-401
P1
A/C POWER ADAPTER 925E
40108-405-502
POWER
SUPPLY
20401-401
J1
20430-401
20547-401
DC WIRE HARNESS FOR CONNECTION DETAILS
SEE AC AND DC POWER DISTRIBUTION DIAGRAM,
20317-503, IN VOL. 2

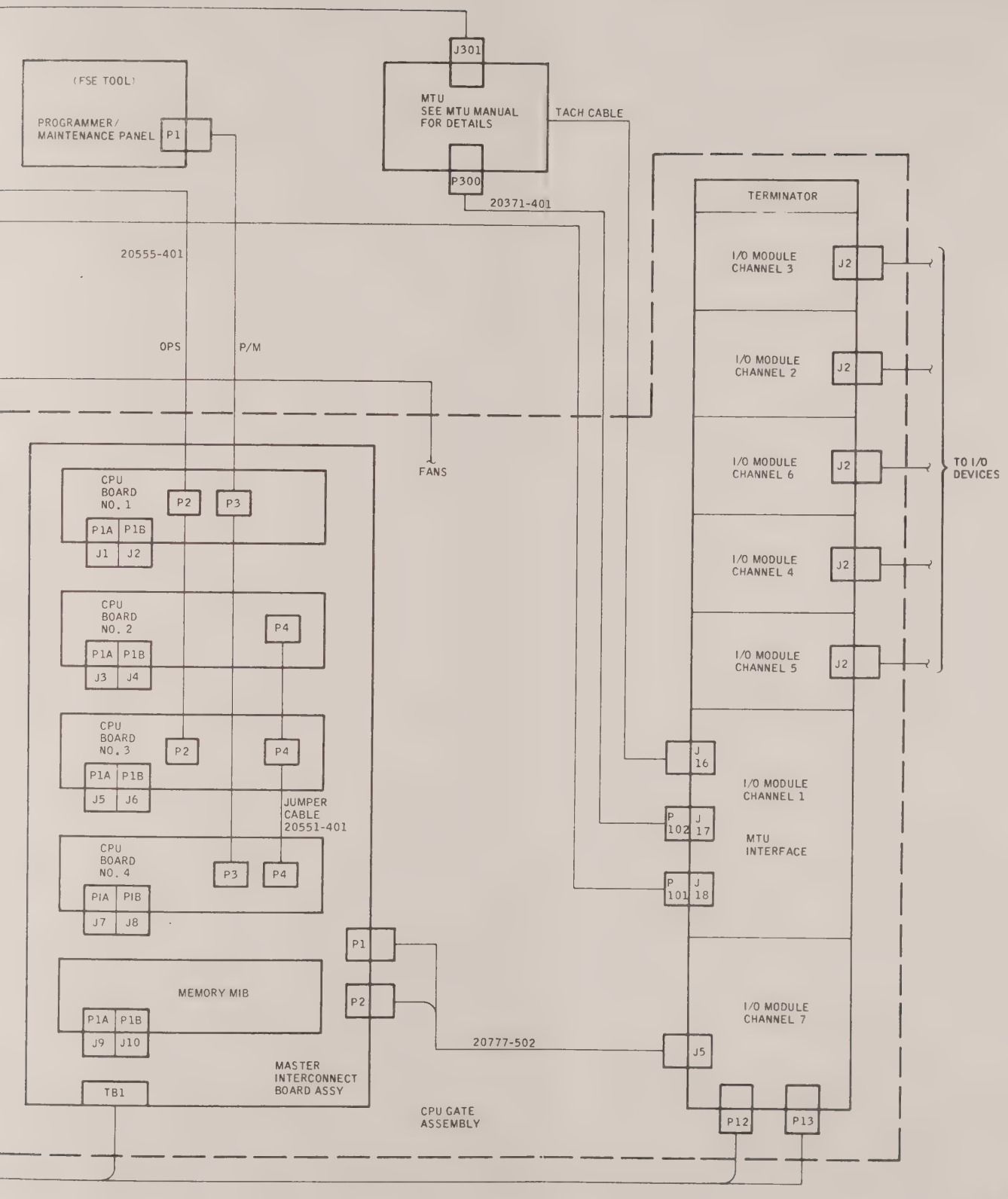


Figure 1-1. Controller Cabling

deposits are excessive, refer the controller operator to the MTU cleaning procedures in the Operation Manual.

- **MTU**

1. Barely moisten a clean, lint-free cloth with alcohol or a good grade, commercial magnetic tape cleaner.

CAUTION

Do not use acetone, carbon tetrachloride, trichloroethylene, or similar solvents. Be sure not to saturate the cloth with the cleaning solution.

2. Remove the MTU read head cover and carefully wipe the pole pieces several times in the direction of tape travel; use a clean part of the cloth each time.

3. Clean the capstan and fixed and roller tape guide shown in Figure 1-2. Take care to avoid getting solvent into the roller bearings. Replace the read head dust cover.

4. Inform the operator that any tape that has been used several times should be cleaned. The tape can be cleaned with a clean cloth moistened with ethyl alcohol or commercial magnetic tape cleaner; the cloth should be held lightly against the oxide side of the moving tape.

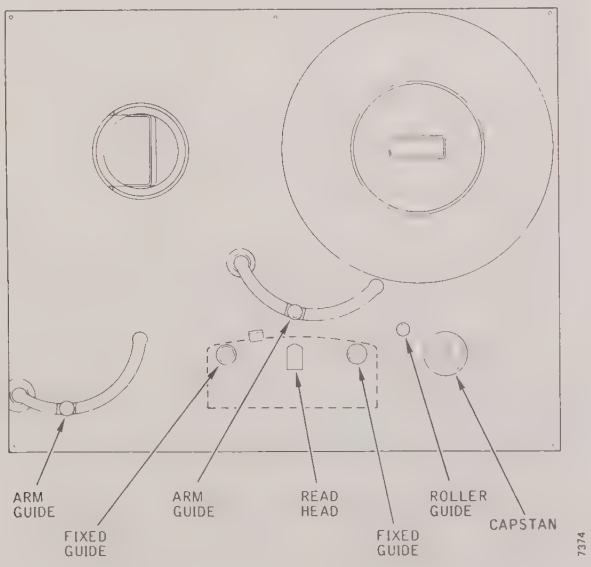


Figure 1-2. MTU Deck Layout

- **Controller Cabinet**

Clean all outside surfaces of the cabinet with a mild detergent.

CONTROL PANEL CLEANING

Use only water and soft cotton to clean the panel. Other solvents and materials will damage the panel.

CONTROL PANEL PUSHBUTTON LAMP REPLACEMENT

The lamps inside the pushbuttons on the operator control panel are replaceable. Use lamps, CalComp P/N 10122-703-001 (IC No. 354480-6).

USING THE OPERATOR CONTROL AND PROGRAMMER/MAINTENANCE PANELS

The operator control panel, shown in Figure 1-3, contains all the controls and indicators normally used by the operator. These controls and indicators, listed in Table 1-2, deal with the normal operation of the CPU and MTU; this includes such functions as turning on system power, loading the MTU, loading the program into memory from the Loader Module, executing the program, and initiating a manual interrupt.

The programmer/maintenance panel is shown in Figure 1-4. The controls, listed in Table 1-3, include facilities for stopping the program, displaying and altering the contents of a selected register, manually stepping through a stored program of discrete instructions, and resuming normal programmed operation.

Schematics for the operator control panel (20604-502) and the programmer/maintenance panel (20776-502) are included in Volume 2.

Loading System Program

1. On the operator control panel, press the PROG LOAD switch/indicator; PROG LOAD and EXEC indicators light. If loading is successful, both indicators go off and a value of 0000 is displayed by the DISPLAY indicators on the operator control panel.

2. If loading is unsuccessful, the EXEC indicator goes off but the PROG LOAD indicator remains lighted.

Data Tape Loading

All controls and indicators for data tape loading are on the operator control panel.

1. Within the limitations of the particular MTU, set the DENSITY switch to the appropriate position.

2. Load the data tape on the MTU.

3. Press the TAPE LOAD button to position the tape at the beginning-of-tape (BOT) marker. Both the TAPE LOAD and BOT indicators light.

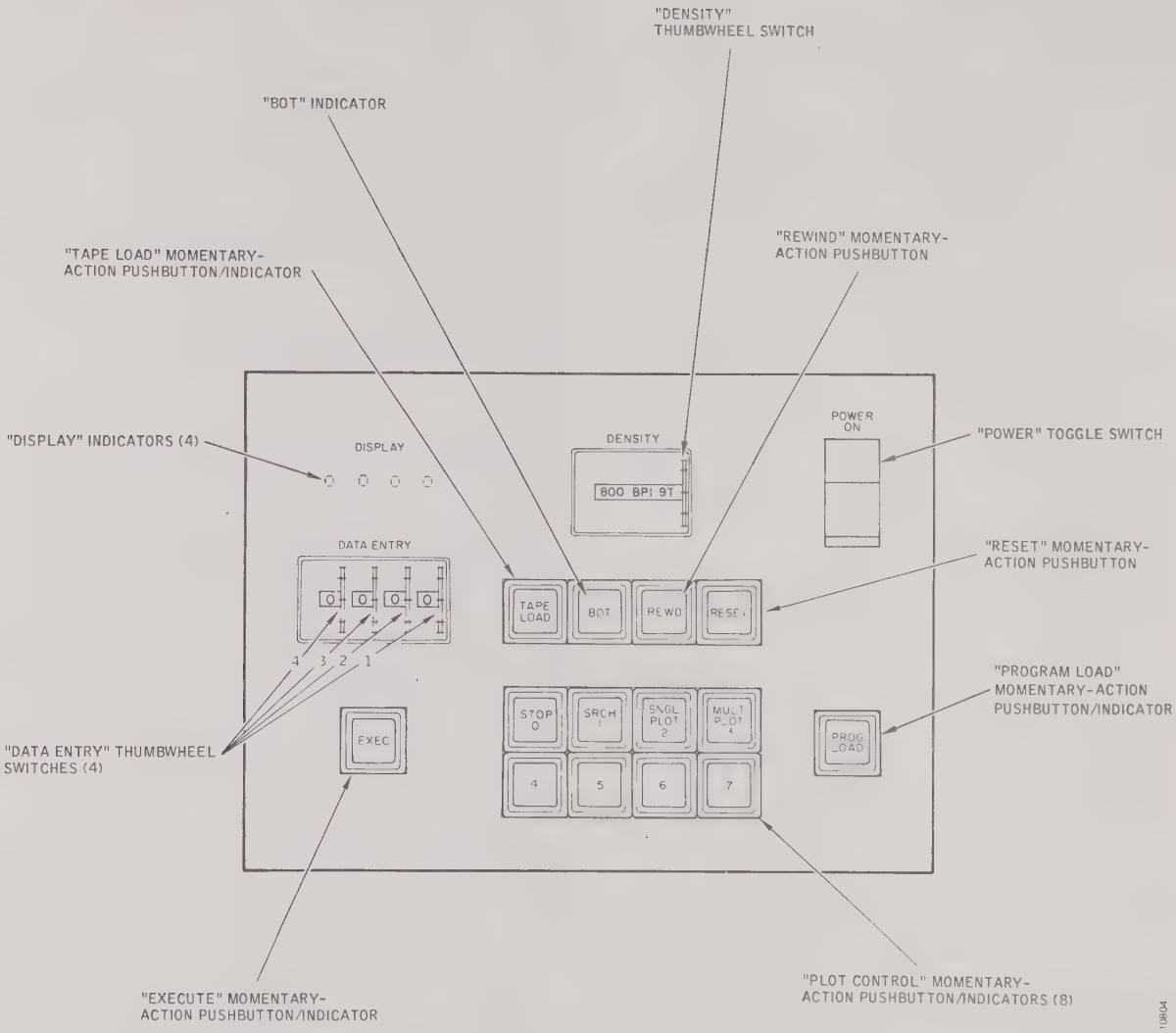


Figure 1-3. Operator Control Panel

TABLE 1-2. CONTROLS AND INDICATORS, OPERATOR CONTROL PANEL

Control or Indicator	Type	Function
EXEC	Momentary-action pushbutton/indicator	Starts program execution while system is in Halt mode, or generates manual interrupt request (if program permits) while system is in Run mode. Lighted when program is being loaded or executed.
Plot Controls STOP 0 SRCH 1 SNGL PLOT 2 MULT PLOT 3 4, 5, 6, 7	Momentary-action pushbutton/indicators	Select status response determined by program.
PROG LOAD	Momentary-action pushbutton/indicator	Loads controller software from Loader Module into memory. Lighted during loading operation; goes off after successful load.

TABLE 1-2. CONTROLS AND INDICATORS, OPERATOR CONTROL PANEL (Continued)

Control or Indicator	Type	Function
RESET	Momentary-action pushbutton	Places magnetic tape unit offline (under operator control).
POWER	Toggle switch	Controls power to controller.
REWD	Momentary-action pushbutton	Rewinds tape on magnetic tape unit (if BOT indicator is not lighted, tape will be rewound to beginning-of-tape marker and MTU will remain under CPU control; if BOT indicator is lighted, tape will be rewound completely and MTU will be placed offline).
DENSITY	Thumbwheel switch	Adjusts magnetic tape unit for compatibility with recording density and track number of tape to be read.
BOT	Indicator	Lighted when magnetic tape unit is stopped by sensing the beginning-of-tape marker on the tape being read.
TAPE LOAD	Momentary-action pushbutton/indicator	Causes tape to advance to beginning-of-tape marker and places magnetic tape unit online. Lighted when magnetic tape unit is online.
DISPLAY	Indicators	Displays numbers as determined by the program while the system is in Run mode; displays contents of A register while system is in Halt mode.
DATA ENTRY	Thumbwheel Switches	Designate data values to be entered into controls.

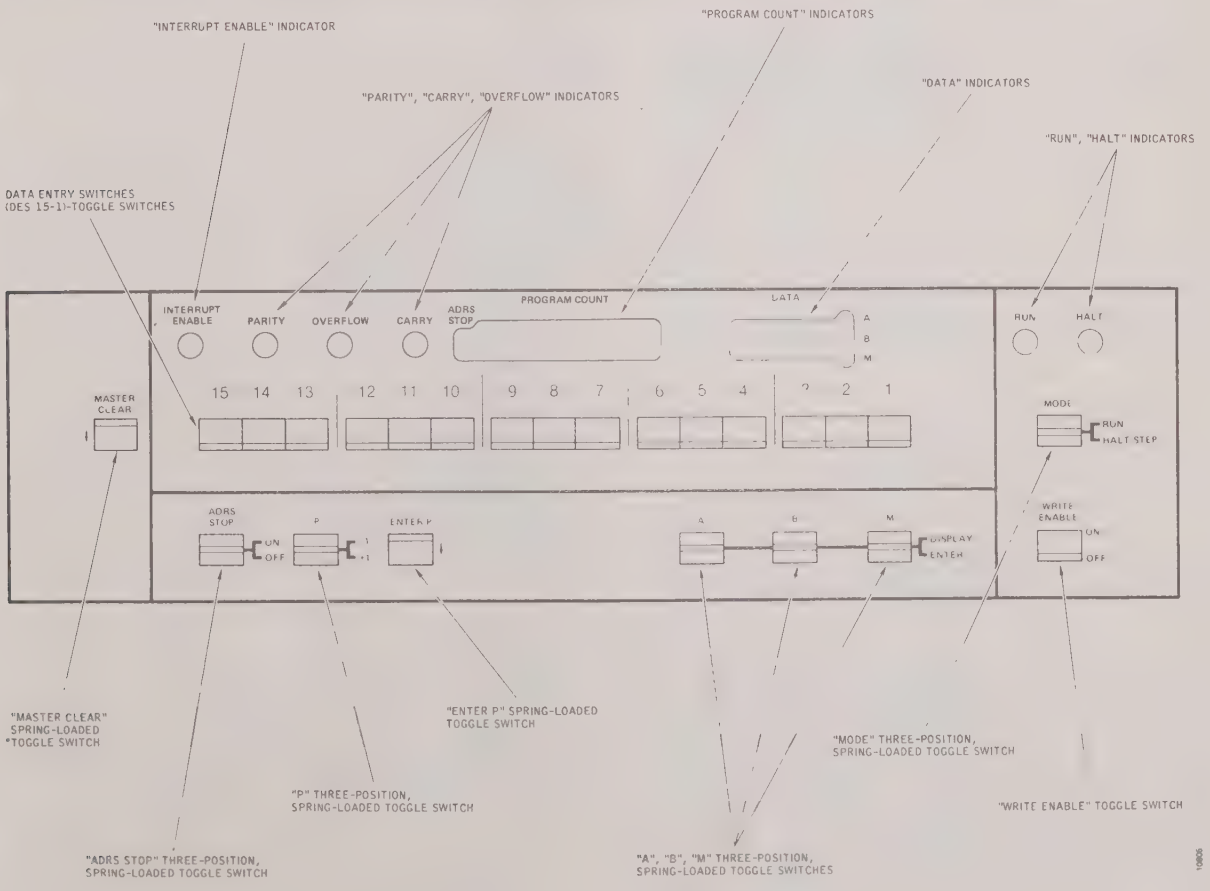


Figure 1-4. Programmer/Maintenance Panel

TABLE 1-3. CONTROLS AND INDICATORS, PROGRAMMER/MAINTENANCE PANEL

Control or Indicator	Type	Function
MASTER CLEAR	Spring-loaded toggle switch	Actuating switch down causes asynchronous exit to Halt mode. CPU stops immediately, and I/O and CPU are initialized.
ADRS STOP	Three-position, spring-loaded toggle switch	Actuating switch to ON position turns on ADRS STOP indicator and causes exit to Halt mode when memory address corresponds to address set on Data Entry Switches (15-1). Actuating switch to OFF position turns off ADRS STOP indicator and disables Address Stop function. (This latter condition is selected when power is turned on.)
P	Three-position, spring-loaded toggle switch	Actuating switch to −1 position decrements or to +1 position increments P register. (Value of P register's contents is displayed on PROGRAM COUNT indicators.)
ENTER P	Spring-loaded, toggle switch	Actuating switch down causes address set on Data Entry Switches (15-1) to be entered into P register.
A, B, M	Three-position, spring-loaded toggle switch	Actuating switch to DISPLAY position causes value contained in associated register to be displayed on DATA indicators and turns on associated register's identification indicator. Actuating switch to ENTER position causes value set on Data Entry Switches (9-1) to be entered into associated register. This position does not affect register identification indicators.
WRITE ENABLE	Toggle switch	Not Used
MODE	Three-position, spring-loaded toggle switch	Actuating switch to RUN position places CPU into Run mode (starts at program count displayed). Actuating switch to HALT/STEP position while CPU is in Run mode places CPU into Halt mode (next instruction to be executed is displayed). Actuating switch to HALT/STEP position while CPU is in Halt mode causes CPU to execute current instruction (displayed) and halt at next instruction.
RUN, HALT	Indicators	Show current operating mode. In Run mode, operator control panel is enabled and Programmer/Maintenance panel (excepting MODE, ADRS STOP, and MASTER CLEAR switches) is disabled. In Halt mode, Operator control panel is disabled and programmer/maintenance panel is enabled. Both indicators are lighted during Step operations.
DATA	Indicators	Three octal indicators show value stored in register designated by lighted A, B, or M indicator. (The A register is selected automatically when power is turned on.)
PROGRAM COUNT	Indicators	Five octal indicators show value stored in P register.
ADRS STOP	Indicator	Indicator is lighted when Address Stop function is selected with ADRS STOP switch.
CARRY OVERFLOW	Indicators	Respective indicator lights when the respective condition occurs in arithmetic operations.
PARITY	Indicator	Lights when memory read parity error is sensed (not MTU parity error). Actuating MASTER CLEAR, or PROG LOAD (on Operator Control panel) turns off indicator.
INTERRUPT ENABLE	Indicator	Lights when CPU interrupt circuits are enabled.

TABLE 1-3. CONTROLS AND INDICATORS, PROGRAMMER/MAINTENANCE PANEL (Continued)

Control or Indicator	Type	Function
Data Entry Switches (DES 15-1)	Toggle switches	Used in conjunction with other switches on programmer/ maintenance panel to enter data or addresses into P, A, B, or M registers. Switch in up position represents binary 1; switch in down position represents binary 0.

Halting the Program

The program can be halted manually in three ways: synchronous, asynchronous, or address stop.

- **Synchronous Halt**

Press the MODE switch to the HALT/STEP position. The HALT indicator will light and, upon completion of the instruction being executed, the CPU will exit to the Halt mode. The program count and the operation code of the next instruction to be executed will be displayed on the PROGRAM COUNT and DATA indicators (M must have been selected for DATA display).

- **Asynchronous Halt**

Press the MASTER CLEAR switch down. The program will stop immediately, and the CPU and I/O will be initialized. (Take care when using this method of halting the program. The CPU exits to the Halt mode regardless of the instruction currently being executed.)

- **Address Stop**

Set the desired memory location address on the Data Entry Switches (DES 15-1), then press the ADRS STOP switch to the ON position. The ADRS STOP indicator will light, and the program will halt after that address is first accessed. (Note that after this method of halting the program, the ADRS STOP switch must be pressed to the OFF position before the CPU will operate continuously in the Run mode.)

The address can be that of an instruction, or it can be an address accessed by an instruction. As pointed out in the examples below, the CPU can be made to exit to the Halt mode after execution of any instruction except for ENI, DSI, SIM, and BOM instructions.

Example 1

m	LIA
m+1	OCT
m+2	XAB

If data entry is set to m or m+1, halt is at m+2
If data entry is set to m+2, halt is at m+3

Example 2 (Instruction and Indirect Address)

m	LIA (I)
m+1	ADRS
m+3	(NEXT INST)
ADRS	OCT ┐
ADRS+1	OCT ┘ INDIRECT ADDRESS

If data entry set to m, m+1, ADRS, or ADRS+1 halt is at m+3

Example 3 (ENI and DSI)

m	ENI
m+1	XAB
m+3	(NEXT INSTRUCTION)

If data entry set to m or m+1, halt is at m+3

Note that the CPU will not halt after executing ENI, but will halt after executing the instruction following ENI. The same is true for DSI.

Example 4 (SIM and BOM)

m	SIM
m+1	OCT ┐
m+2	OCT ┘ POINTER
m+3	XAB
m+4	(NEXT INSTRUCTION)

If data entry is set to m, m+2, m+3, or POINTER, halt is at m+4

Note that CPU will not halt after executing SIM, but will halt after executing the instruction following SIM. The same is true for BOM.

Displaying Contents of, and Entering Data Into Memory and Registers

1. Halt the program. Use the Synchronous Halt, or, for a particular memory location, the Address Stop procedure. The contents of the P register will be displayed on the PROGRAM COUNT indicators.

2. Press any register switch (A, B, or M) to the DISPLAY position. Contents of the respective register (M is the memory buffer) will be displayed on the DATA indicators.

3. Use P switch positions −1 and +1 to display the contents of or to gain access to adjacent memory locations.

4. To enter data, set the Data Entry Switches (DES 15-1 for the P register or DES 9-1 for the A, B, or M register), then press the respective register switch (ENTER P down or A, B, M to the ENTER position). Always set the data on the Data Entry Switches before pressing the register switch. Note that the ENTER position on the A, B, and M switches does not affect the DATA display unless the respective register has been selected for display.

Single-Stepping the Program

To execute a single instruction, press the MODE switch to the STEP position. Repeating this action executes successive instructions in a program. Interrupts cannot be serviced when stepping programs.

Using the Static Clock

The static clock control switches (STAT/NORM, 1-CLK, and CASEL) are located on CPU board No. 4. (See Figure 1-5.) the STAT/NORM switch enables/disables the circuit. When the circuit is enabled (STAT switch in down position), a single, system-clock pulse is generated each time the 1-CLK switch is pressed. The CASEL switch in the down position causes the value in the ROM address register (CA1-CA8) to be displayed on the DATA indicators (programmer/maintenance panel). This display facilitates tracing through the microprogram.

STEP CYCLE:

To step through an instruction cycle in static clock, select the desired instruction so it is indicated in the display memory indicators (Display M). Place S2 to STATIC CLOCK (Down). Place S3 to CASEL (Down). The data indicators should display all zeros (idle state). Initiate and hold STEP or RUN, successively press S1 (one shot) until the RUN/EXECUTE indicators illuminate. Release STEP/RUN. Data indicators should display "001." Using the micro program flow chart, the instruction may now be stepped through its cycle.

ENTER CYCLE:

To step through an enter cycle, place S2 to STATIC CLOCK (Down). Place S3 to CASEL (Down). Press and hold the desired enter switch (P, A, B or M); successively press S1 (one shot) until the RUN/EXECUTE indicators illuminate. Release enter switch. Check the micro program flow chart for the correct display in the data indicators for the enter cycle selected.

COMPONENT LOCATION

Figure 1-6 shows the locations of controller components at the top assembly level. Drawings showing the components at the subassembly level are in the section of the manual covering the appropriate subassembly.

INTERFACE MODULES

The controller has eight I/O channels. The first channel (address 0) services the operator control panel switches and indicators, the manual interrupt circuits, and the page-zero control logic. The remaining channels service up to seven peripheral devices. Interface circuits for channel 0 are hardwired within the CPU (see LD16 and LD17). Interface circuits for each peripheral device are on piggyback modules, which are so called because each module plugs into a preceding one in the chain as shown in Figure 1-7.

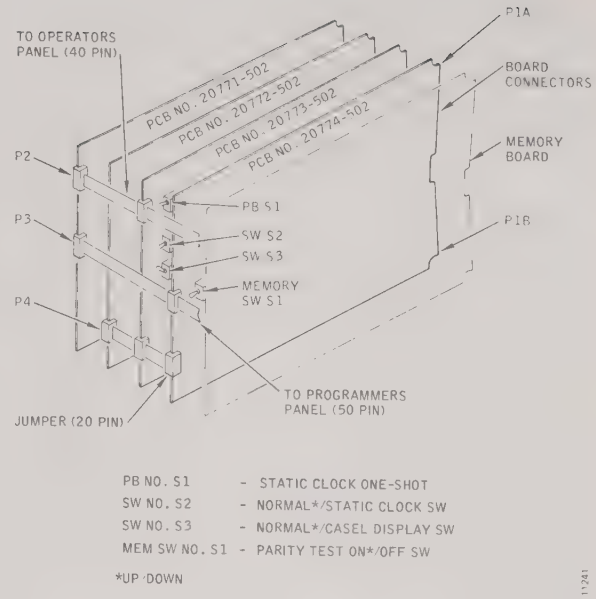


Figure 1-5. CPU/Memory Board Locations

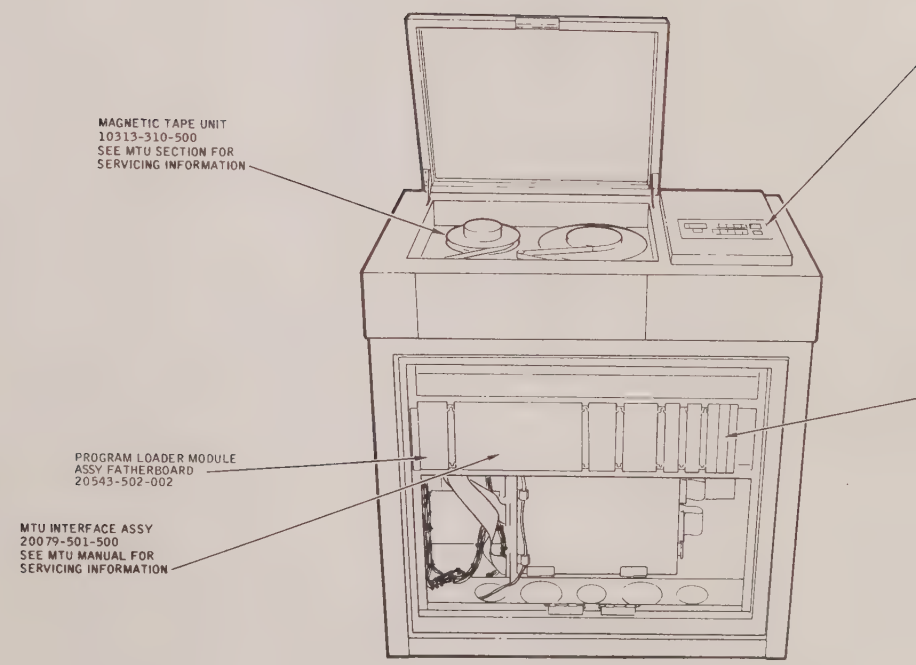
Types of I/O Modules

There are two types of I/O modules: those that occupy succeeding positions in the chain. The first type is called a fatherboard; the second, a motherboard.

Both types of modules have an incoming piggyback jack and an outgoing plug; however, the incoming piggyback jack for the channel 7 module is mounted directly on the surface of the fatherboard. Input/output data and control signals are routed through a cable from the CPU MIB (Master Interconnect Board) to the incoming piggyback jack of the channel 7 module. These signals are made available on the outgoing piggyback plug that mates with the incoming piggyback jack of the next module. Note that the incoming piggyback jacks of successive modules are on the edge of the motherboard. The channel 7 module has terminal lugs that are connected to ground, +5v, +15v, and −15v. These voltages are supplied to successive modules through the piggyback jacks and plugs.

Piggyback Connections

The incoming piggyback jack and outgoing piggyback plug on each module have fixed pin-for-pin connections, except for the pins allocated to the interrupt and address lines. Figure 1-9 shows pin connections and logic implementation of the address and interrupt request (PCI) lines for all modules. Note that the connections for the channel 7 module are unique and those for all other modules are the same. This connecting scheme ensures that the addresses of successive modules are fixed (7, 1, 5, 4, 6, 2, 3) by virtue of their position in the piggyback chain. The interrupt requests from each module is


LOCATION OF MASTER POWER SWITCH
MAGNETIC TAPE UNIT
10313-310-500
SEE MTU SECTION FOR
SERVICING INFORMATION
PROGRAM LOADER MODULE
ASSY FATHERBOARD
20543-502-002
MTU INTERFACE ASSY
20079-501-500
SEE MTU MANUAL FOR
SERVICING INFORMATION

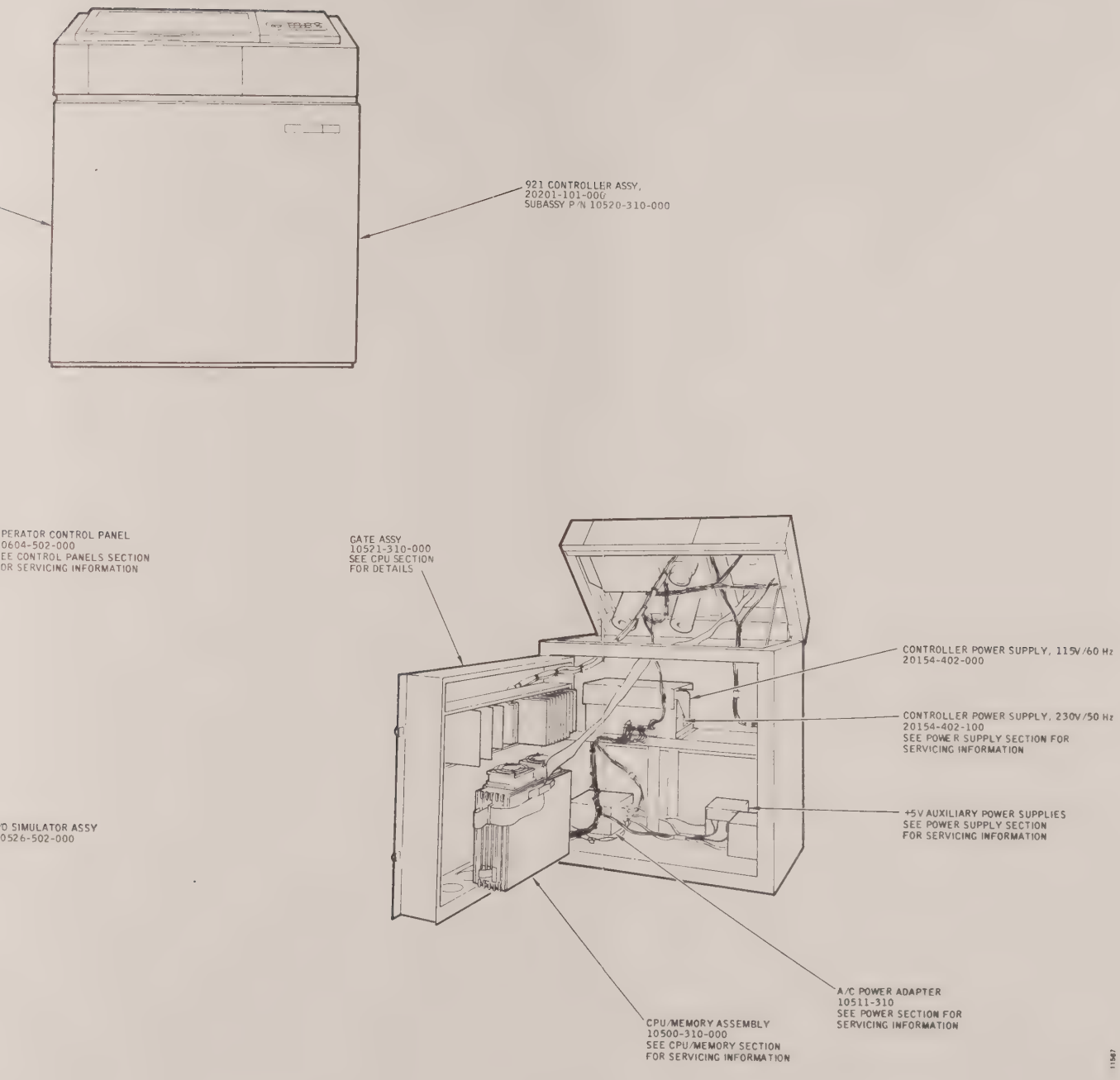


Figure 1-6. Controller Component Locations

1C1

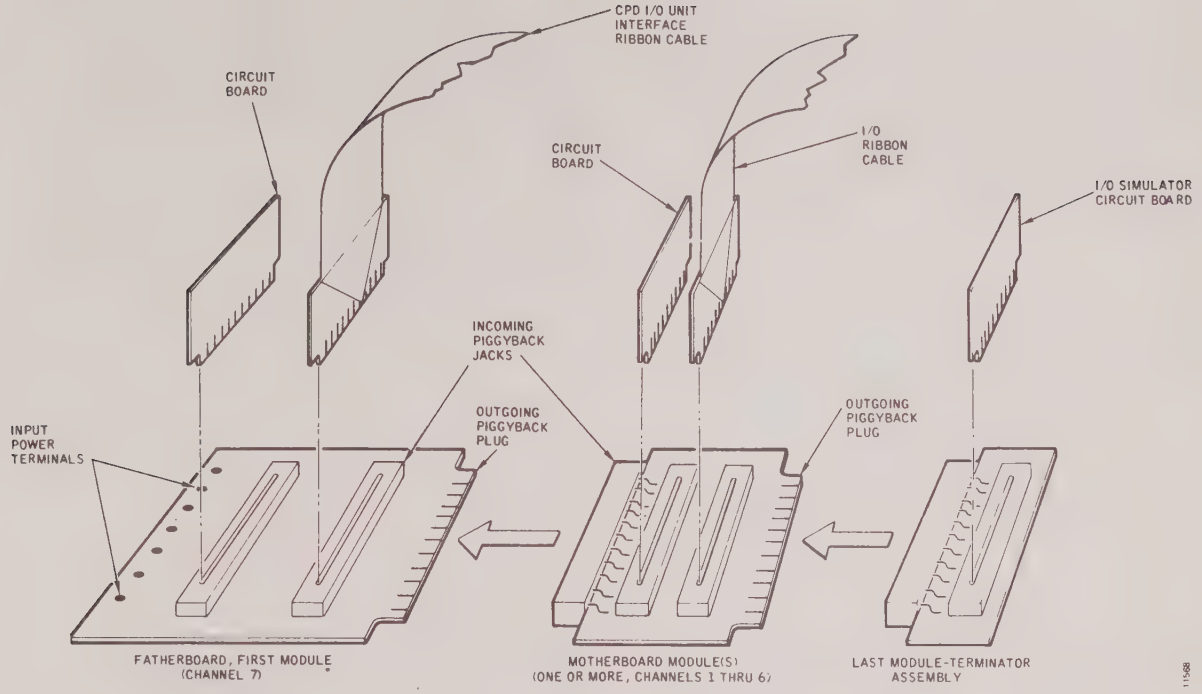


Figure 1-7. Typical I/O Module Connection Scheme

collector-ORed with the correct bit positions on the input data buses (PC01/ thru PC08/) within the channel 7 module. Note that the bit positions correspond to the channel numbers of the module from which the interrupt requests originate.

Connecting Cables

I/O motherboard and fatherboard modules are connected to their respective output devices by individual cables as illustrated in Figure 1-1. The fatherboard has an additional cable that links it with the CPU MIB. Part numbers of the cables that connect the modules to the CPU connector panel are listed in the individual I/O module data.

Terminator

The termination module is always connected to the piggyback plug of the last motherboard module in the chain as illustrated in Figures 1-7 and 1-9.

LOADER MODULE

System programs are contained in read-only memories (ROMs) mounted on the program loaded module. The loader module is installed in I/O channel 7. Different sets of ROMs are used for the various models of plotters to be controlled (see below).

Plotter	Loader Module	I.C. Number
936 3 Bit GCS	20871-502-100	435320-7
500 Series	20871-502-200	435330-6
836	20871-502-300	435340-5
936	20871-502-400	435350-4
960	20871-502-500	435360-3
103X (1037, 1038, 1039)	20871-502-600	450950-1
1051	20871-502-700	450960-0
103X 3 Bit GCS	20871-502-800	452490-6
1055	20871-502-900	471310-3
1012	20871-502-911	479960-7

The 921 Controller uses the same program loader module for the 1037, 1038 and 1039 plotters. Because of the plotter speed and pen selection differences, each of these three plotters has been assigned a specific setting of the number 3 and 4 positions of the status word switch S1 on the program loader module. These two previously unused switch positions control the status lines PC07 and PC08 thereby allowing the 921 to determine which of the 103X plotters is being used.

For purposes of defining the state of the switch positions, the switch position is considered in its defined state when the switch element is depressed, i.e., if all elements on the + side of the switch were depressed, the state of the switch would be 00000.

Switch position one (1) defines the bit configuration: S1-1 = 0 for 8 Bit and S1-1 = 1 for 6 Bit. Switch position two (2) is used in the 936 loader module to differentiate between an inch plotter and a metric plotter. (S1-2 = 0 for inch and S1-2 = 1 for metric. Switch positions three (3) and four (4) are set as follows:

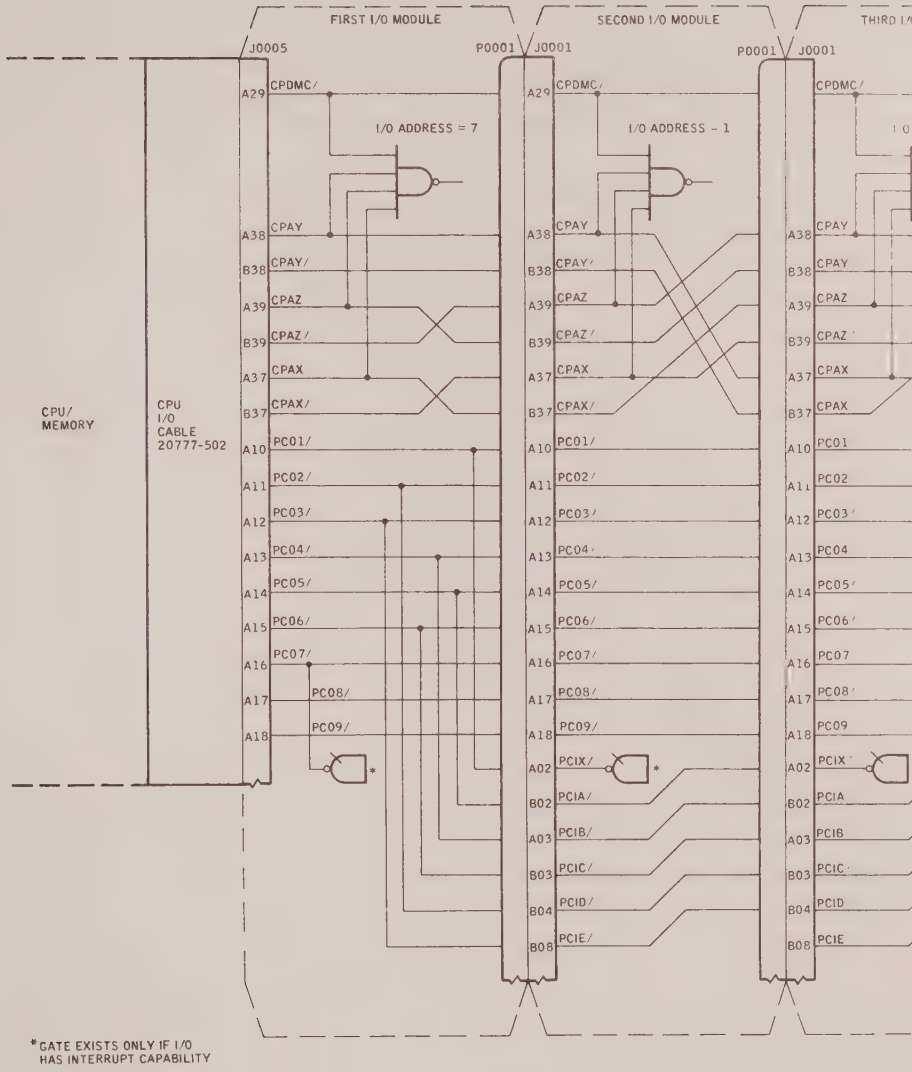
1039 Plotter	S1-3 = 0	S1-4 = 0
1038 Plotter	S1-3 = 0	S1-4 = 1
1037 Plotter	S1-3 = 1	S1-4 = 0

Switch position five (5) defines the loading media: S1-5 = 0 for ROM Data Loading and S1-5 = 1 for Diagnostic Tape Loading.

It is important to note that the status word switch positions are sensed only after initial load. If a switch position element is changed after the system is loaded, the system must be re-loaded to ensure switch element detection.

Note

For 3 Bit GCS operation S1-1 will be placed in the 6 Bit position; i.e., S1-1 = 1.


FIRST I/O MODULE
SECOND I/O MODULE
THIRD I/O
J0005
P0001
J0001
P0001
J0001
CPU/
MEMORY
CPU
I/O
CABLE
20777-502
I/O ADDRESS = 7
I/O ADDRESS - 1
A29 CPDMC/
A38 CPAY
B38 CPAY/
A39 CPAZ
B39 CPAZ/
A37 CPAX
B37 CPAX/
A10 PC01/
A11 PC02/
A12 PC03/
A13 PC04/
A14 PC05/
A15 PC06/
A16 PC07/
A17 PC08/
A18 PC09/
A02 PCIX/
B02 PCIA/
A03 PCIB/
B03 PCIC/
B04 PCID/
B08 PCIE/
*GATE EXISTS ONLY IF I/O
HAS INTERRUPT CAPABILITY

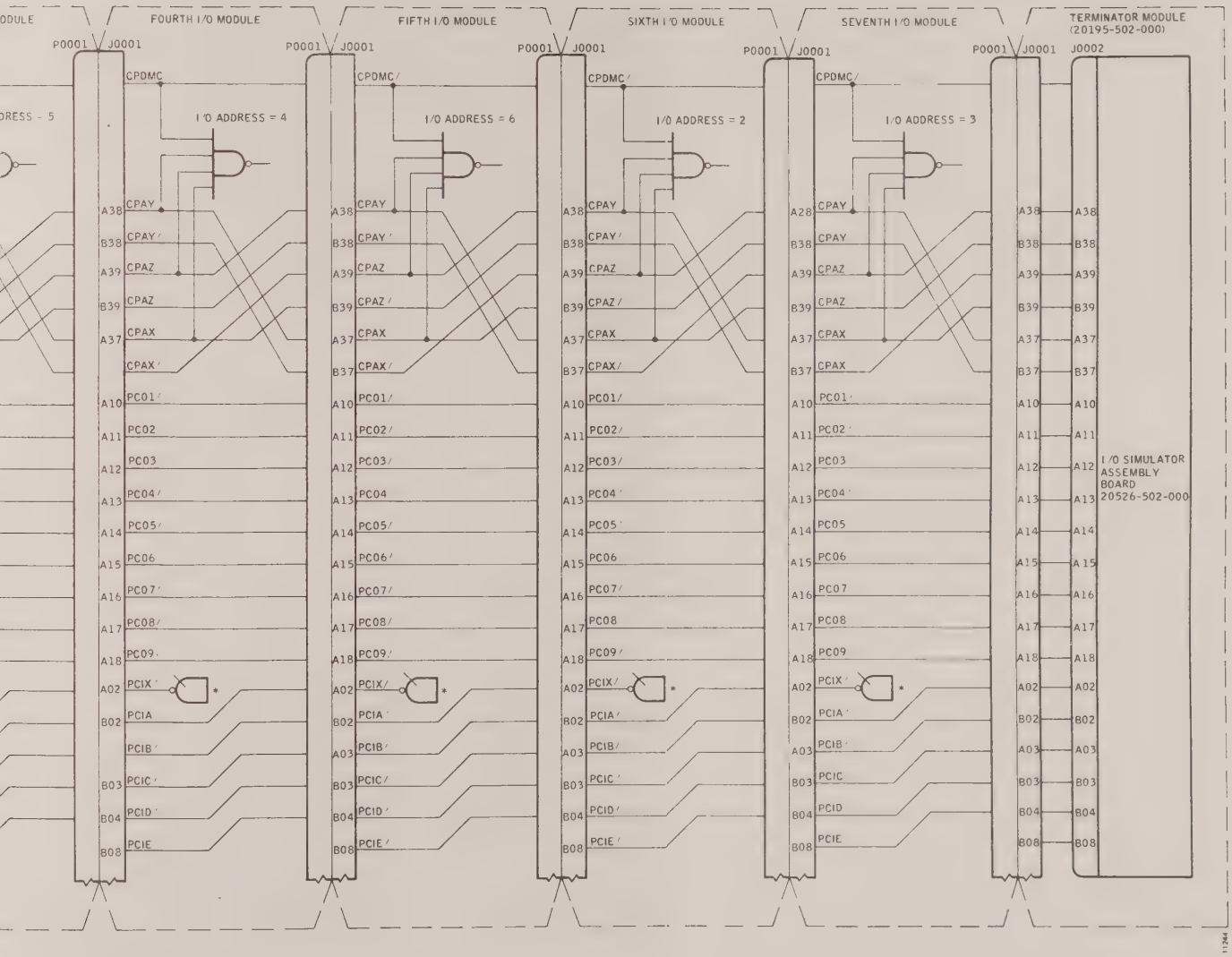


Figure 1-9. I/O Module Address and Interrupt Connections

SECTION 2

POWER SUPPLY

Section 2
POWER SUPPLY

CONTROL AND FUSE LOCATIONS

The master power switch and line fuse are located on the ac power adapter. The master power switch is accessible through a hole in the lower left side of the controller; the fuseholder is accessible when the gate assembly of the controller is opened. Fuse type for the line fuse is FNM 8A (for 90-130v) and FNM 5A (for 208-260v). The locations of controls and fuses on the power supply are shown in Figure 2-1.

SCHEMATICS AND ASSEMBLY DRAWINGS

A list of these drawings is given in Table 2-1. Schematic and assembly drawings are in Volume 2. The maintenance Term Wire List for the power supply follows.

TABLE 2-1. SCHEMATICS AND ASSEMBLY DRAWINGS

Title	Number
Ac and Dc Power Distribution	20317-503
Controller Power Supply (Assy)	20154-402
Schematic, 910/915	20241-503
Power Supply Assembly 910/915	20508-502
Schematic, Ac Power Adapter	20314-503
Ac Power Adapter (Assy)	10511-310
Controller Dc Wire	20547-401

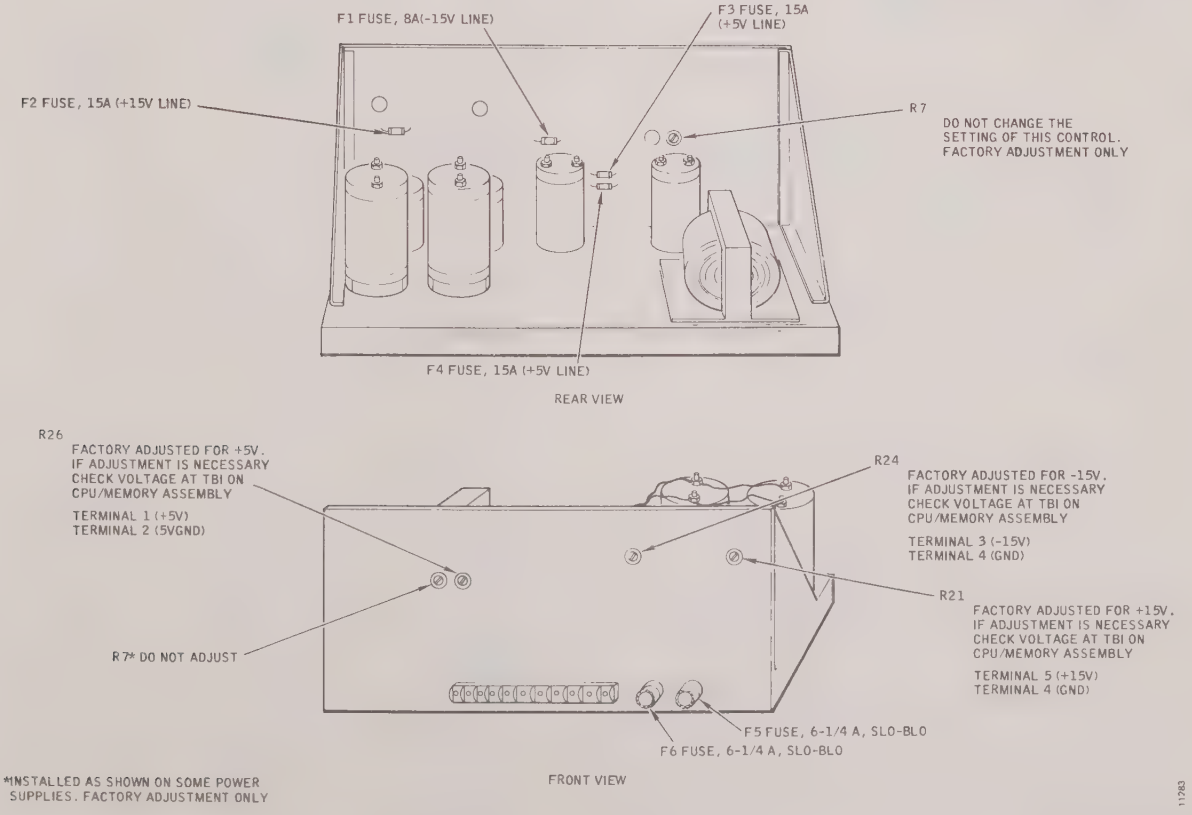


Figure 2-1. Power Supply Controls and Fuse Locations

+5 VDC BUS CURRENT

The controller power supply provides 15A of current on the +5 vdc bus. Any additional current demands must be furnished by an auxiliary power supply. Each auxiliary supply provides 12A.

The minimum current requirement for the controller is 7.17A: Basic CPU 5.4A, fatherboard 1.07A, and I/O simulator 0.7A. Add to this the requirement for one or more assemblies as listed in Table 2-2.

TABLE 2-2. CURRENT REQUIREMENTS FOR ADDITIONAL ASSEMBLIES

Assembly	Current (A)
Core Memory:	
8K	1.92
MTU Option:	
7 Track NRZI	3.60
9 Track NRZI	3.60
7/9 Track NRZI	4.00
9 Track PE	5.90
7/9 Track NRZI-PE	9.00
I/O Module:	
P-1	0.45
P-4	0.60
P-14	0.67

Note

An auxiliary power supply must be installed in the controller equipped with 1600 BPI MTU when the total current demand is within 0.5A of the controller current limit.

For the controller wiring modification and installation instructions, refer to the following.

INSTALLATION PROCEDURE FOR THE +5V AUXILIARY POWER SUPPLY

The +5v auxiliary power supply must be installed when the I/O current demand is within 1/2A of the maximum limit of the available current. For specific current requirements of different I/O modules, refer to the +5 vdc Bus Current limitations, above.

There are two modification kits: Kit 20239-801-000 for 100/115 vac systems, and Kit 20239-801-002 for 208/230 vac systems. Except for the wire and cable arrangements, both kits contain the same parts. In each case, approximately 4 hours are required to install the kit.

Inspect terminal board T1 on the left rear corner of the controller power supply. The location of blue jumpers on this terminal indicates the power configuration of the system as defined in Table 2-3.

MAINTENANCE WIRE TERM LIST

Control 710 Modification 2	Power Supply — Controller 10/05/72	
12AC1	T001-13	DA03-AC1
12AC2	T001-15	DA03-AC2
14ZC1	T001-18	DA04-AC2
14AC2	T001-16	DA04-AC1
18AC1	T001-12	DA02-AC2
18AC2	T001-10	DA02-AC1
18AC3	T001-09	DA01-AC2
18AC4	T001-07	DA01-AC1
AC1-CB	T001-03	T001-06
AC2-CB	T001-01	T001-04
TCAP-1	T001-RED1	C007-A
TCAP-2	T001-RED2	C007-B
+12C	DA03-POS	C002-POS
+12C	C002-POS	E001
+14U	DA04-POS	C005-POS
+14U	C005-POS	E020
+15B	Q002-B	E010
+15B	Q001-B	E010
+15E1	Q001-E	E004
+15E2	Q002-E	E006
+18UA	T001-11	C001-POS
+18UA	C001-POS	E009
+18UA	Q001-C	C001-POS
+18UA	Q002-C	C001-POS
+18UB	T001-08	C006-POS
+18UB	C006-POS	E015
+35VA	DA02-POS	E008
+36VB	DA01-POS	E014
+5B	Q003-B	E018
+5B	Q004-B	E018
+5EF3	Q003-E	E012
+5EF4	Q004-E	E013
+6.7U	T001-17	C003-POS
+6.7U	C003-POS	E016
+6.7U	Q003-C	C003-POS
+6.7U	Q004-C	C003-POS
−12C	DA03-NEG	C004-NEG
−12C	C004-NEG	E002
−15V	DA01-NEG	C006-NEG
−15V	C006-NEG	E011
GRD M	T001-14	C004-POS
GRD M	C002-NEG	E005
GRD M	C002-NEG	C004-POS
GRD+15R	DA01-NEG	C001-NEG
GRD+15R	C001-NEG	E003
GRD+5R	DA04-NEG	C003-NEG
GRD+5R	C005-NEG	E017
GRD+5R	C003-NEG	C005-NEG

TABLE 2-3. POWER CONFIGURATION

Power Supply Voltage	Jumpers	
	From	To
100 vac	T1-2B	T1-4B
	T1-3B	T1-5B
115 vac	T1-1B	T1-4B
	T1-3B	T1-6B
208 vac	T1-2C	T1-6C
230 vac	T1-1B	T1-6C

1. Place the power supply (20150-402-000) on the plate assembly (21035-203-000) and secure it with the four 10-32 x 1/2 flat head screws, four No. 10 flat washers, four No. 10 lockwashers, and four No. 10 hex-head nuts. Be sure to check that the countersunk side of the mounting plate is facing down. The hardware should be installed in the following order: screw through the bottom of the plate and through the power supply; then flat washer, lockwasher, and hex-head nut on top.

2. Place the power supply assembly in the controller with the terminal block on the power supply facing the front of the controller. Secure the assembly in place with the four, 6-32 self-tapping screws and the No. 6 flat washers.

3. Remove the cover from the ac power adapter on the bottom of the controller.

4. Remove the plug from a hole in front of the power adapter (see Drawing 10511-310 in Volume 2), and install cable clamp 10020-206-001 in the hole.

5. Route cable 20416-401-003 from the new +5-volt power supply through the cable clamp and into the power adapter. Connect the leads of the cable to the new power supply and to the power adapter terminal blocks as shown in drawing 20317-503 (in Volume 2).

6. Route cable 20439-401-000 between the new power supply and I/O fatherboard 20543-502-000. The cable end with connector P1 goes to the fatherboard. With ties spaced at 6-inch intervals, secure the cable to the other cables on the CPU gate.

7. Disconnect the existing +5 vdc bus connector from J13 on the fatherboard; connect new cable connector P1 to J13.

8. Connect the other end of the cable to the new power supply, as indicated below.

Color	Connection
Black	PS4
Red	PS1

9. Type or print the following data on Modification Nameplate 11139-204-000: "Mod Kit No. 20239-001" (or -002, as applicable), the date incorporated, and the description "Modified for Aux Pwr Supply +5v."

10. Affix the modification nameplate on the inside right panel of the controller below the system identification tag.

SECTION 3

CPU/MEMORY ASSEMBLY

Section 3
CPU/MEMORY ASSEMBLY

The CPU/Memory assembly comprises the Master Interconnect Board (MIB), four CPU boards, and the memory MIB. Figure 1-5 shows the CPU/Memory configuration. Schematics and assembly drawings are in Volume 2; a list of these drawings is given in Table 3-1.

TABLE 3-1. CPU/MEMORY SCHEMATICS AND ASSEMBLY

Title	Number
CPU/Memory Assy	10506-301
CPU Board No. 1	20771-502
CPU Board No. 2	20772-502
CPU Board No. 3	20773-502
CPU Board No. 4	20774-502
Memory Module	20775-502
MIB Assembly	20778-502
Memory MIB	20779-502

CPU FAULT ISOLATION

Malfunctions in the CPU can be isolated to the circuit level by using the troubleshooting aids listed in Table 3-2. Use these aids with the procedure given in Table 3-3. Note that ROM addresses in the microprogram flow chart are given both in octal and hexadecimal. (Octal is the radix used for display on the Programmer/Maintenance panel; hexadecimal is the radix used in microprogram word notation in the memory set document, 70110-508.)

TRACING SIGNALS IN LOGIC DIAGRAMS

The logic diagrams (LDs) cover circuits in the CPU and memory only. On-page referencing of signals is by circled numbers, and off-page referencing is by circled letters (best used for tracing a signal to the source). Signals leaving an LD along with the destination LD number are listed above diagrams. Signals that originate in or go to I/O devices or control panels are referenced to the source or destination by a phrase on the LD. Tracing these signals will require the use of drawings in Volume 2 for the referenced cable and device.

TABLE 3-2. TROUBLESHOOTING AIDS

Aid	Location
Diagnostic Tape	FSE Has
Diagnostic Listing	Volume 1
Microprogram Flow Chart	Volume 1
Memory Set, Microprogram ROMs, 70110-508-000	Volume 1
Logic Diagrams	Volume 1
Format and Field Names Figure 3-1	Volume 1

TABLE 3-3. FAULT ISOLATION PROCEDURE

Operation	Result
Load and run diagnostic tape.	Program halts at failing subroutine.
Locate failing subroutine in diagnostic listing.	
Execute failing subroutine step by step while comparing displays on Programmer/Maintenance panel with diagnostic listing.	Incorrect displays indicate failing instruction.
Load address of failing instruction into P counter.	
On CPU board 4, set CA switch to ON (up) and Static Clock switch to static (down).	*Microprogram ROM* addresses will be displayed on DATA indicators in octal.
Map route of failing instruction listing all *microprogram ROM* addresses in octal.	

TABLE 3-3. FAULT ISOLATION PROCEDURE
(Continued)

Operation	Result
One-shot failing instruction through microprogram while comparing DATA display with listing of address mapped. Analyze microprogram word of last successfully attained address for probable cause of fault and check LDs to isolate to circuit level.	Incorrect address indicates area of fault

DMC REGISTER TEST

This test causes each bit of the DMC counter and pointer registers to toggle between 1's and 0's. Failure of a bit to toggle indicates a faulty register.

- Load the controller with the program listed in Table 3-4.
- Execute the program from location 00000.

TABLE 3-4. DMC TOGGLE LOOP PROGRAM

Location	Data
00000	414
00001	006
00002	414
00003	010
00004	610
00005	000
00006	770
00007	777
00010	000
00011	000

DIRECT MEMORY CONTROL TEST

This test aids in troubleshooting direct memory control (DMC) problems that could be caused by a tracking error between the DMC count and the DMC pointer. The test advances the DMC count and the DMC pointer registers by one each time the DMC mode is entered. So as not to destroy the information in memory when entering the DMC mode, be sure to ground PCW/ at pin A23 of J0005 of the loader module I/O board; then select the DMC mode by grounding PCD/ at pin A22 of J0005.

A standard timing sequence is obtained by using only one jump instruction, 610-000, that is loaded into locations 00000 and 00001. Entering 00000 into the P register and pressing the EXECUTE switch generates a sequence of signals from the DMC registers.

Since the DMC registers are used as a count, the duration of each bit in the register is 50 percent of the duration of the next more-significant bit. The count of 77777_8 one-sets DOV for one DMC mode control cycle. If the conditions are not as indicated above, troubleshoot in the dynamic mode. The circuits involved in this test are as follows:

- DMC counter register LD5
- DMC pointer register LD5
- DOV flip-flop LD7
- Sum bus LD8
- ALU LD7
- DMC flip-flop LD16-2

MEMORY

The memory comprises two basic assemblies: the memory MIB, containing the control logic, and the memory modules that mount directly on the memory MIB (see LD1-1, LD1-2, and LD2). Each module is 8K.

Nominal memory access time is 490 nanoseconds (average); however, the memory sends a data acknowledge (DA/=0) early after all timing requirements are met. Because of this, the overall effective system access times are 400 or 450 nanoseconds for read and 350 or 400 nanoseconds for write. (There are two possible times for read or write access because of inherent skew in the memory timing signals. These signals are somewhat asynchronous to the CPU clock. The exact time depends on which clock edge DA/ is detected by the CPU.) Hereafter, the average read and write access times will be assumed to be 425 and 375 nanoseconds, respectively.

When the CPU makes a memory request (MS=1), it also freezes its clock generator (see Figure 3-2). MS initiates a memory cycle, and after the timing requirements of the signals (MA01-15, MB1-MB9, ODPAR, and READ) from the CPU are met, the memory responds with data acknowledge (DA/=0) to enable the clock generator in the CPU. A DA reset signal (DARST/) from the CPU forces DA/ high asynchronously, thereby completing the effective memory cycle. Remember that at the completion of an effective memory access, the memory is still in the same access cycle, which must be completed before another access cycle can be initiated. This means that successive memory access cycles will take somewhat longer to complete. However, only a few instructions in the CPU require successive access cycles.

8K MODULES

An 8K module (see LD2) has two, independently addressable, 4K sections. Each 4K section consists of ten

ROM NUMBER		11	10		9	
WORD BIT POSITION		43 42 41	40 39	38 37 36 35 34		33 32 31
FIELD NAME		AD	AG	ARITH		SB
BINARY VALUE		4 2 1	2 1	16 8 4 2 1		4 2 1
FUNCTION		ADDEND SOURCE	AUGEND SOURCE	ADDER FUNCTION		SUM BUS SOURCE
COUNT		0 - 15	0 - 15	0 - 15	16 - 31	0 - 15
0	16	MA	MB	AD + CI		I/O
1	17	P	G	AD/		SUM RL3
2	18	DC	A		AD + AG	SUM RS6
3	19	DP	B			SUM RR3
4	20	MA 10-15 MB 1 - 9				SUM RL1
5	21	MB 1-9 G 4-9			AG	SUM RR1
6	22	A			AD · AG	SUM
7	23	B		ZERO		SUM NOTE 1
8	24					
9	25					
10	26					
11	27			AG/		
12	28			AD-AG-CI/		
13	29			AD ⊕ AG	AD∨AG	
14	30				AD - CI/	
15	31				AD	

NOTES:

1. SUM (GATED WITH I2/)
2. MB FROM SUM BUS (OTHERWISE MB FROM MD)
3. TOGGLE A, REG FOR PARITY
4. 00 = HOLD CTP & OV
   01 = ENABLE CTP & OV SET & RESET
   10 = ENABLE CTP & OV SET ONLY
   11 = HOLD CTI
5. I
6. I
7. I
8. A
9. E

Micro Program ROM Word
Format and Field Names

8	7	6	5	4	3	2	1
30 29 28	27 26	25 24	23	22 21	20 19	18 17	16 15 14 13 12	11 10 9 8	7 6 5 4 3 2 1 0
DS	A	B	G	CI	CO	MEM	SPECIAL	TEST	NEXT ADDRESS
4 2 1	2 1	2 1	1	2 1	2 1	2 1	16 8 4 2 1	8 4 2 1	128 64 32 16 8 4 2 1
SEP P, MA, DC, DP REG	A REG SOURCE	B REG SOURCE	SET G REG	CI/ EQUALS	CONTROL FOR CTP/OV	MEM REPO/ WRITE	SPECIAL CODES FOR UNIQUE OPERATIONS	BRANCH PARAMETERS	ROM ADDRESS OF NEXT MICRO WORD
0 - 15	0 - 15	0 - 15	0-15	0 - 15	0 - 15	0 - 15	0 - 15 | 16 - 31	0 - 15	ABSOLUTE ADDRESS OF NEXT ROM LOCATION TO BE ACCESSED. CAN BE MODIFIED BY CONTENTS OF TEST FIELD
NOOP	NOTE 3	SUM BUS	NOOP	1	NOTE 4	---	--- | B → SHIFT	NONE	
MA	SUM BUS	SUM BUS	MB	0		WRITE	SET I1-9 | A→ SHIFT	TO INSTR START	
P	B	A		CTP/		READ	SET I1-3 | A9 AND MB → SHIFT	ON A9 (AMAG SMAG)	
DC	NOOP	NOOP		CTI/		NOOP	NOTE 5 | SET CPD	ON CTI	
DP							NOTE 6 | SET C5	TO INDIRECT OR E1	
NOTE 2							NOTE 7 | SET CPC	TO END	
DC AND DP							$\overline{AD}$ | ENABLE DOV	JUMP TEST	
MA AND DP							NOTE 8 | ENABLE INTRPT	TO E2	
							$\overline{AG}$ IF I1/ OR I2/ | NOTE 9	ON MB9	
							$\overline{AG6 - 9}$ | SET HALT	ON MB9/	
							$\overline{INTRPT}$ | RESET LOAD	ON MD1 EXO MD2	
							AG = 001 IF A9 | SIM OR BOM	ON PCR	
							AG = 002 | DMC EXIT	ON CTI OR PCES	
							$\overline{AD\ 10 - 15}$	ON PANEL SWITCHES	
							$\overline{SB\ 1 - 3}$	ON I4, I3, I2	
							$\overline{SHIFT}$	ON PCES	

1A9, AG OUT = 001, OTHERWISE 000

TI, AG OUT = 002, OTHERWISE 000

1A9, AG OUT = 002, OTHERWISE 000

OUT = 010 IF I1 I2/, 020 IF I1/I2, 000 IF NEITHER

BLE PANEL DATA ENTRY TO INPUT BUS

SYMBOLOGY:

+	=	ADD
-	=	SUBTRACT
·	=	LOGICAL AND
∨	=	LOGICAL OR
⊕	=	EXCLUSIVE OR
$\overline{AD}$	=	DISABLE ADDEND (TYPICAL)
→	=	TO
&	=	AND

11153

Figure 3-1. Format and Field Names

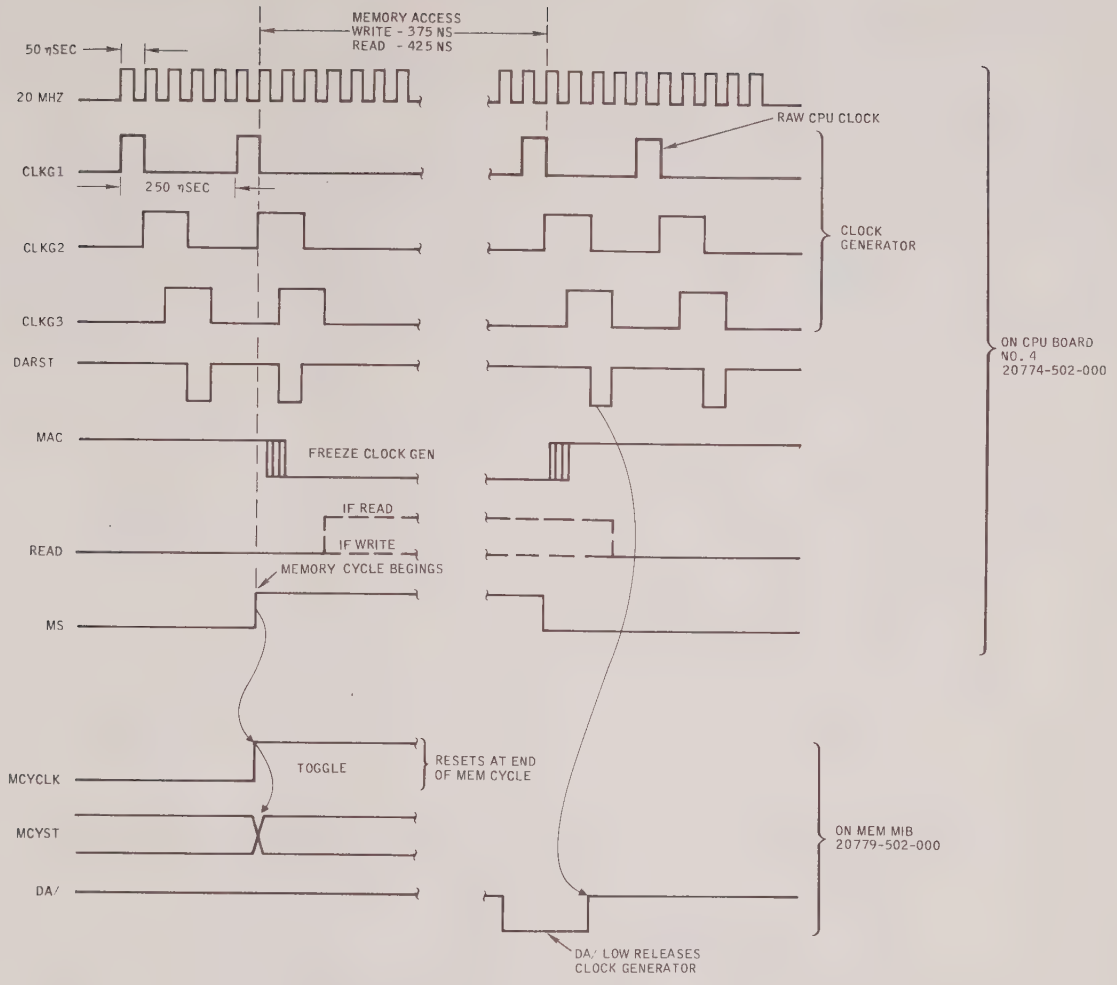


Figure 3-2. CPU/Memory Interface Control Timing

1 X 4K MOS RAMs. The first nine RAMSs (bits 1 thru 9) store the data words, and the last RAM (bit 10) stores the odd-parity bits for corresponding data words. The odd-parity bits are generated in the CPU.

The 8K module also contains a +12v regulator and drivers for various RAM input signals. The pin assignment for each 16-pin RAM is as follows:

Pin	Nomenclature	Definition
1	−5v	— — — —
2	MBX/	Write data input
3	W/	R/W control; L=write, H=read
4	RASX/	Row address strobe
5	A0	Address Bit 1
6	A2	Address Bit 3
7	A1	Address Bit 2
8	+12v	— — — —
9	+5v	— — — —
10	A5	Address Bit 6
11	A4	Address Bit 5
12	A3	Address Bit 4
13	CS/	Chip select; L=chip selected
14	MDX/	Read data output
15	CAS/	Column address strobe
16	GRD	— — — —

Note that RAS is conditionally gated to each 4K bank (RAS1/ and RAS2/). During read and write cycles, only the selected bank is strobed by RAS. The other bank not strobed by RAS remains in the idle state. During refresh cycles, the control logic on the MIB holds CS low and raises both select lines (1ST4K and 2ND4K) to gate RAS to all RAMs. The RAMs, in this case, ignore CAS and MBX/ inputs and place their MDX/ (tristate) lines in the open-circuit condition. The exact timing relationship of all inputs and outputs is described below.

MEMORY CYCLES AND TIMING

The memory operates in one of three cycles: read and write cycles that are initiated by the CPU, and a refresh cycle that is automatically initiated by the memory control circuits. The refresh cycle, which has priority over read and write cycles, occurs every 28.8 microseconds to refresh data stored in memory.

Refresh cycles are required to maintain the charge stored by the parasitic capacitances within the memory circuits in the RAMs. Characteristically, the stored charges — reflecting the ones and zeros of data words — discharge within a few milliseconds if the RAMs are not refreshed.

The same basic timing signals are generated for read, write, and refresh cycles (see Figure 3-3). Timing intervals of all signals are determined by two 250-nanosecond delay lines. Because of inherent delays of the driving and logic elements associated with the delay lines, the relative times illustrated in the figure

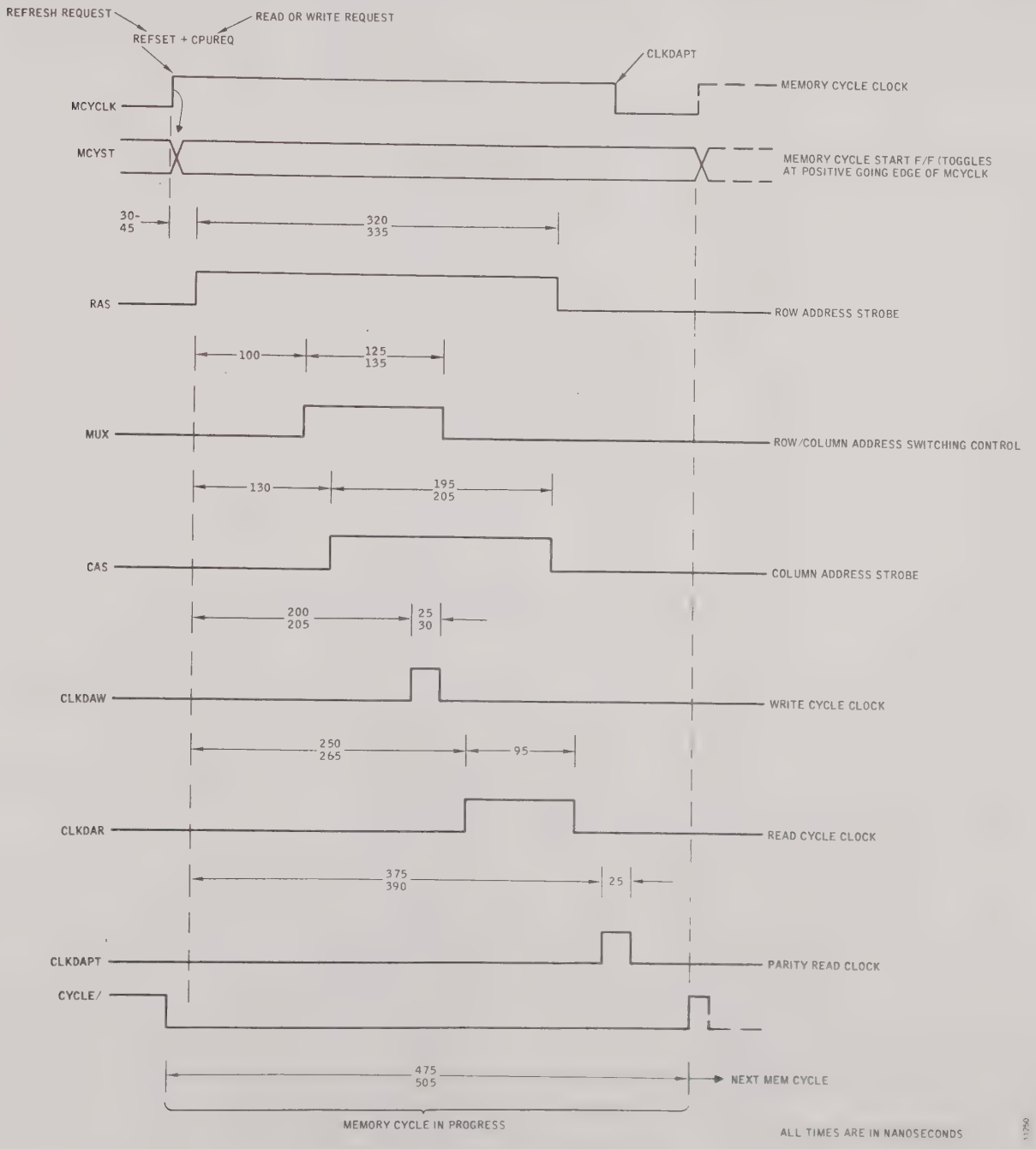


Figure 3-3. Basic Memory Timing

are nominal and do not necessarily match the times designated at the output taps of the delay line (see LD1-2).

Refresh Cycle

The refresh cycle timing is illustrated in Figure 3-4. Only those signals that are significant during a refresh cycle are shown. As far as the RAMs are concerned, the only requirement for refresh is that each row address, which is the address gated via A0-A5 at the positive-going edge of RAS, must be strobed by RAS every 2 milliseconds. The state of CAS and WRITE signals are not significant during refresh cycles. Chip select CS is held low to minimize power drawn by the RAMs during the refresh cycle.

All RAMs are refreshed simultaneously by holding the bank select gates (SEL14K-SEL84K) high during the refresh cycle. Outputs of these gates enable RAS inputs to all memory banks — this gating takes place on the 8K module PCBs.

The refresh timing signal (REFT) and refresh count (address) are derived from the 1.25 MHz clock from the CPU. Refresh request flip-flop REFR is set at the

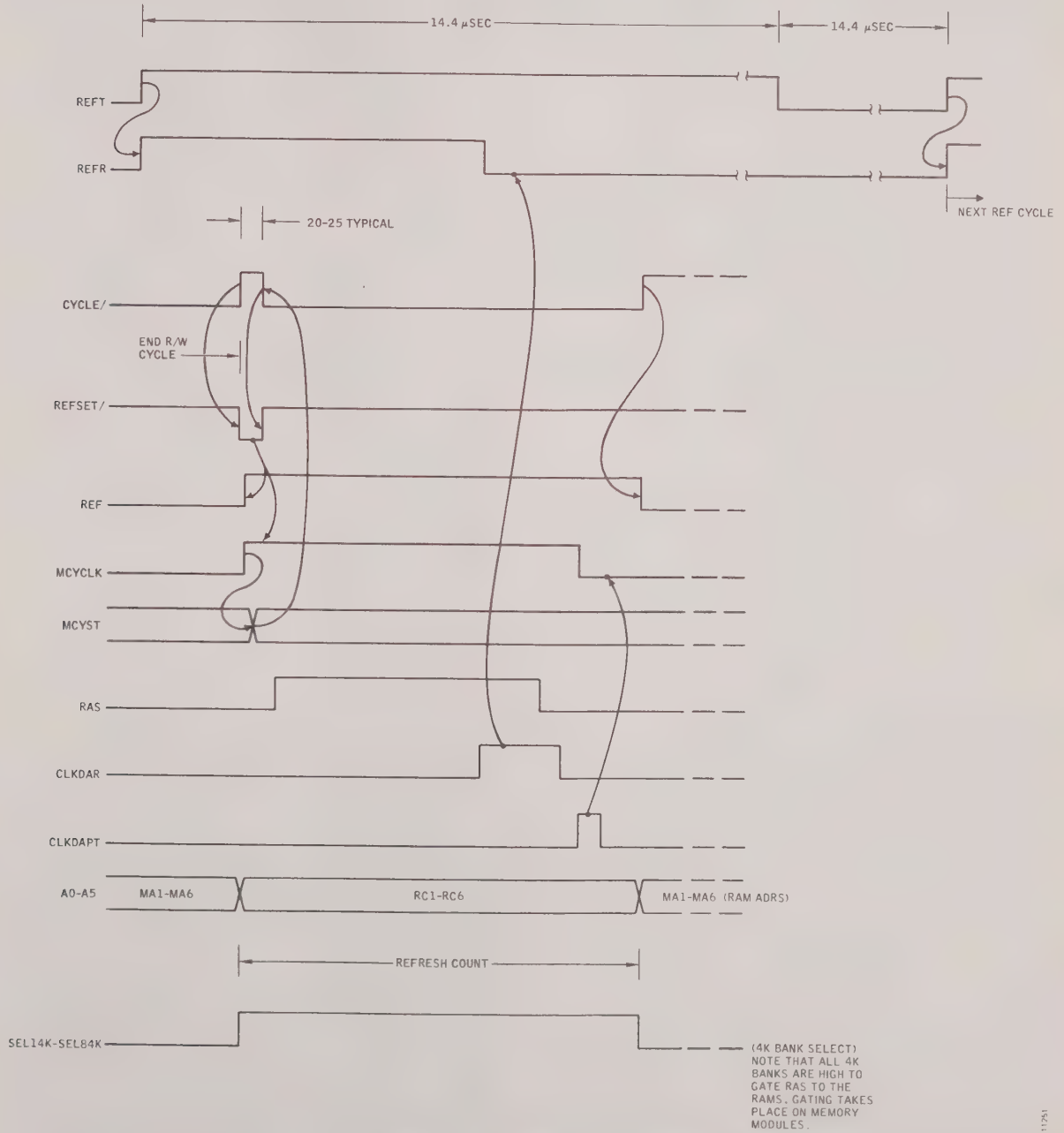


Figure 3-4. Refresh Cycle Timing

positive-going edge of REFT, a 34.72 KHz signal, every 28.8 microseconds to request a refresh cycle. If a read or write cycle is not in progress (CYCLE/=1), refresh flip-flop REF is set immediately to initiate a refresh cycle; otherwise, REF is set when the current cycle is complete, that is, when CYCLE/ goes high.

With REF set, refresh address RC1-RC6 is selected as the address input (A0-A5) to the memory modules.

Since REFT and RC1-RC6 are from contiguous stages of binary counters, RC1-RC6 advances binarily from 0-63 and advances by one count every 28.8 microseconds. Note that RC1-RC6 goes through one complete cycle in 1.843 milliseconds, which is well within the refresh rate of 2 milliseconds required for the RAMs to maintain data integrity.

Write Cycle Timing

The write timing cycle is illustrated in Figure 3-5. A write cycle is initiated when the CPU raises the memory strobe (MS) line. If, however, the memory is being refreshed (CYCLE/=0), MS will be serviced at the end of the refresh cycle when CYCLE/ goes high. Hence, with CYCLE/ high, MCYCLK is set and MCYST is toggled to trigger the delay line.

Memory address MA01-MA12 from the CPU is the address to be written into, and memory address MA13-MA15 selects the 4K bank to be accessed.

MA15-MA13	4K Bank	
000	SEL14K	8K Module No. 1
001	SEL24K	
010	SEL34K	8K Module No. 2
011	SEL44K	
100	SEL54K	8K Module No. 3
101	SEL64K	
110	SEL74K	8K Module No. 4
111	SEL84K	

Depending on the state of MA13-MA15, a corresponding bank-select line (SELX4K) is raised to allow RAS to strobe the selected 4K bank. The gating of RAS takes place on the 8K PCB.

Multiplexing of the location address (MA01-MA12) is controlled by MUX:

MUX	A0-A5	
0	MA1-MA06	Row address
1	MA07-MA12	Column address

At the selected 4K bank, the row address is read at the negative-going edge of RAS, and the column address is read at the negative-going edge of CAS.

Notice that data acknowledge (DA/) goes low at the positive-going edge of CLKDAW, which occurs before

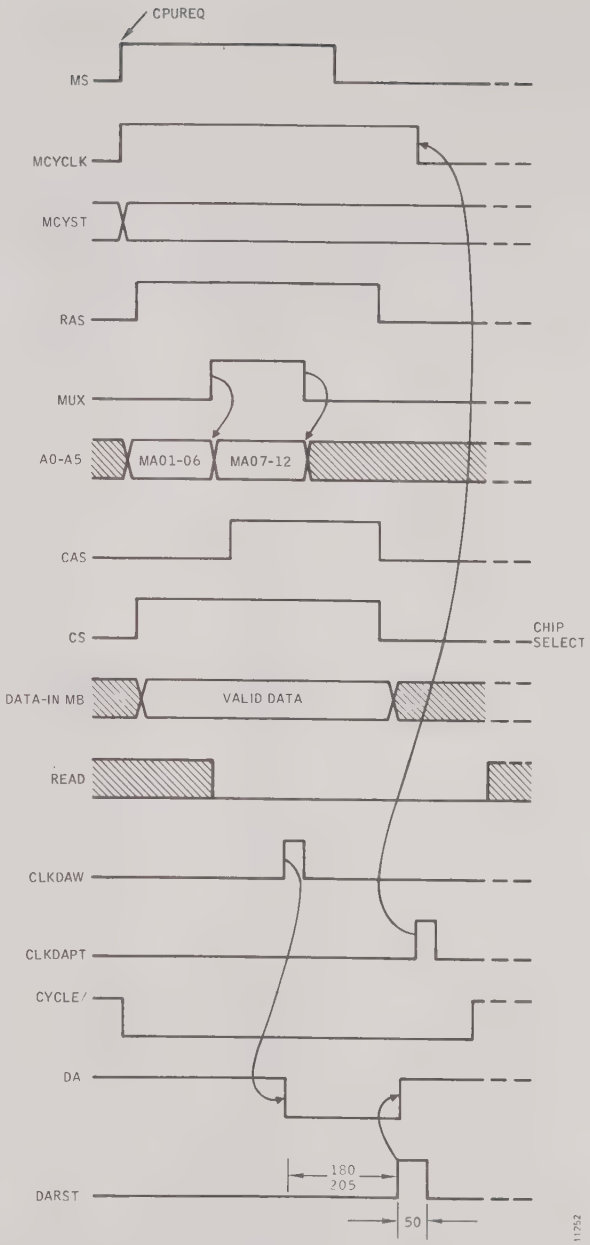


Figure 3-5. Write Cycle Timing

CYCLE/ goes high again at the end of the write memory cycle. This releases the CPU early and thereby shortens the effective ystem write-access time.

Read Cycle Timing

Adverting to Figure 3-6, the timing for read cycles is similar to the timing for write cycles described previously. The exceptions are that the READ signal is high and DA/ goes low later, that is, at the leading edge of CLKDAR. When DA/ goes low, the data lines (MD1-MD9) are read by the CPU. Concurrently, the parity of each accessed word is checked.

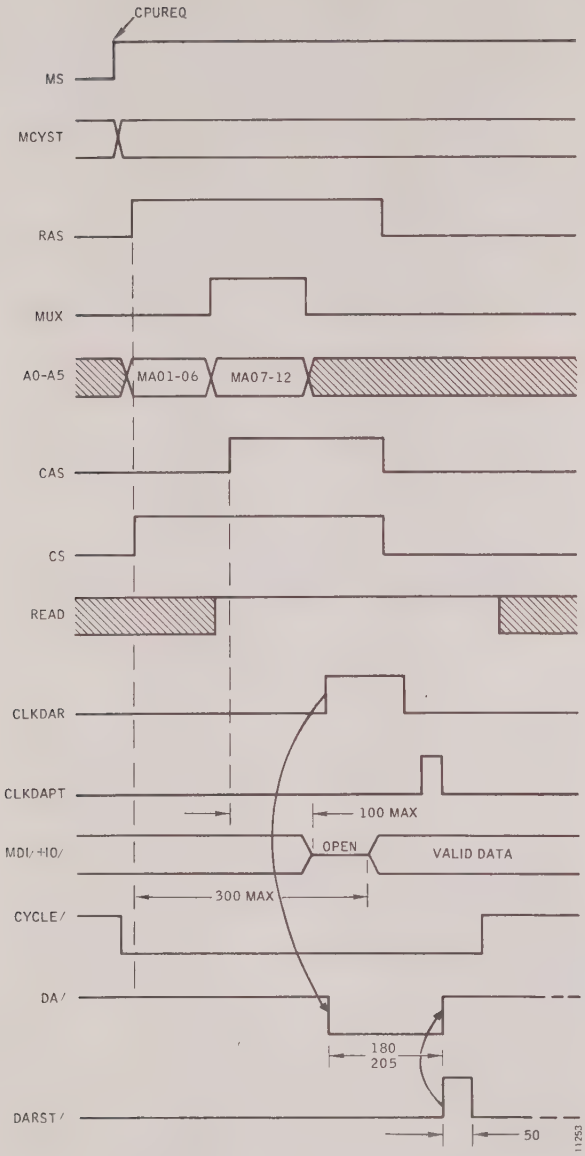


Figure 3-6. Read Cycle Timing

Since each data word as written into memory reflects odd parity, an even parity check is performed at every read access cycle. Hence, if the parity is even, an error has occurred, and the PARITY flip-flop is set at the trailing edge of CLKDAR. This flip-flop is clocked at the trailing edge of CLKDAR to allow sufficient time for the RAM output data lines to settle. When PARITY is set, the PARITY indicator on the Programmer/Maintenance panel is turned on. Pressing MASTER CLEAR on the panel asynchronously resets the PARITY flip-flop and, consequently, turns off the indicator.

The parity test feature is operable wahen the switch on the edge of the memory MIB is placed in the test position (up). In this case, the timing of DA is modified so that it can set with CLKDAPT, provided that no parity error has been detected (PARITY/=1) — see Figure 3-7. If a parity error occurs (PARITY/=0), CLKDAPT is inhibited. This prevents DA from setting, thereby preventing the CPU from releasing its clock system. Because the CPU Clock system is kept frozen, MS is held high and the memory will continuously reexecute cycles until one of two conditions occur: MASTER CLEAR on the Programmer/Maintenance Panel is pressed, or the parity test switch is placed in the normal position (down). The former will asynchronously reinitialize the memory and CPU, and the latter will cause DA/ to be set at the leading edge of CLKDAR to allow the CPU to enable its clock system as it would under normal nontest conditions.

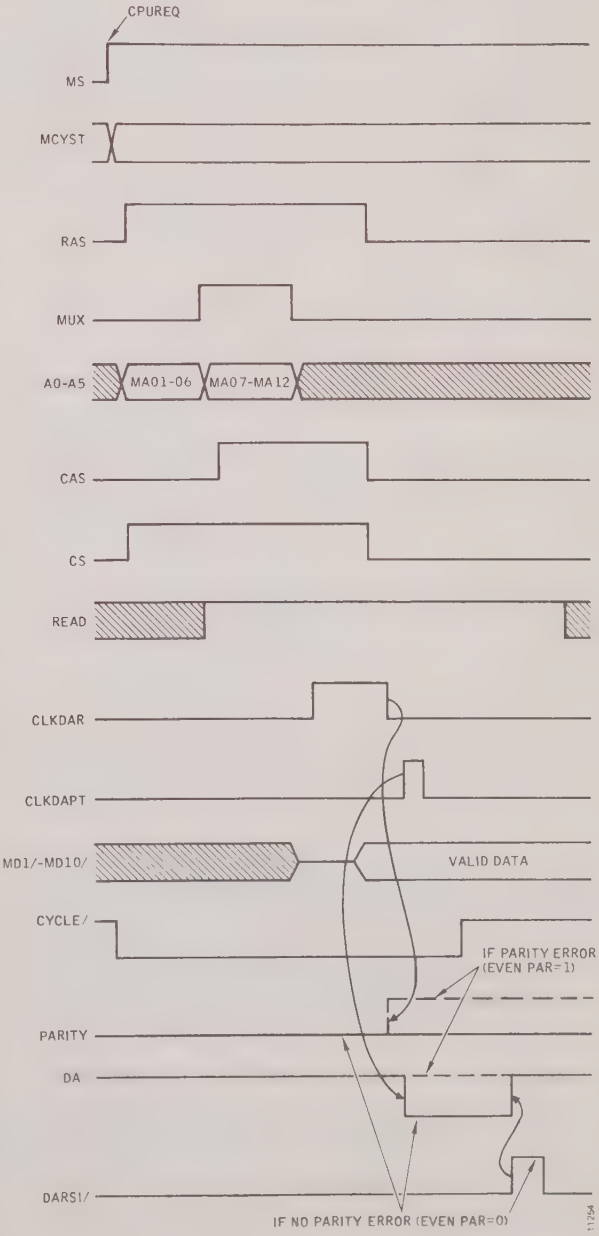


Figure 3-7. Read Cycle Timing, Parity Test Mode

RAM TIMING TOLERANCES

The absolute minimum and maximum timing relationships of the RAM are indicated on Figure 3-8. One should be aware that the relative timing of the signals illustrated in this figure is *not* the actual timing observed at the inputs to the RAM; instead, it simply points out the minimum or maximum times the actual signals can change without violating the RAM timing specifications. Hence, whenever the actual signals are monitored, one can observe any timing violations between signals by referring to Figure 3-8.

CHECKING MEMORY

The most thorough method of checking the memory is at the system level. Most malfunctions can be isolated through existing diagnostics and control panel functions.

1. Install the memory and run the CPU and memory diagnostics.
2. The memory can be assumed to be operating correctly if the diagnostics run with no errors indicated by either the software or the PARITY indicator on the Programmer/Maintenance panel (P/MPNL). If an error occurs, proceed to Step 3.
3. Clear Memory
   - Starting at location zero, enter:

     360 SIM
     000 POINTER
     000
     000 HALT
   - Set the PROGRAM COUNT, A, and B registers to zero.
   - Press MASTER CLEAR if the PARITY indicator is on.
   - Press EXECUTE (or RUN).
4. Set the PARITY TEST switch, on the memory MIB, to the test position (up).

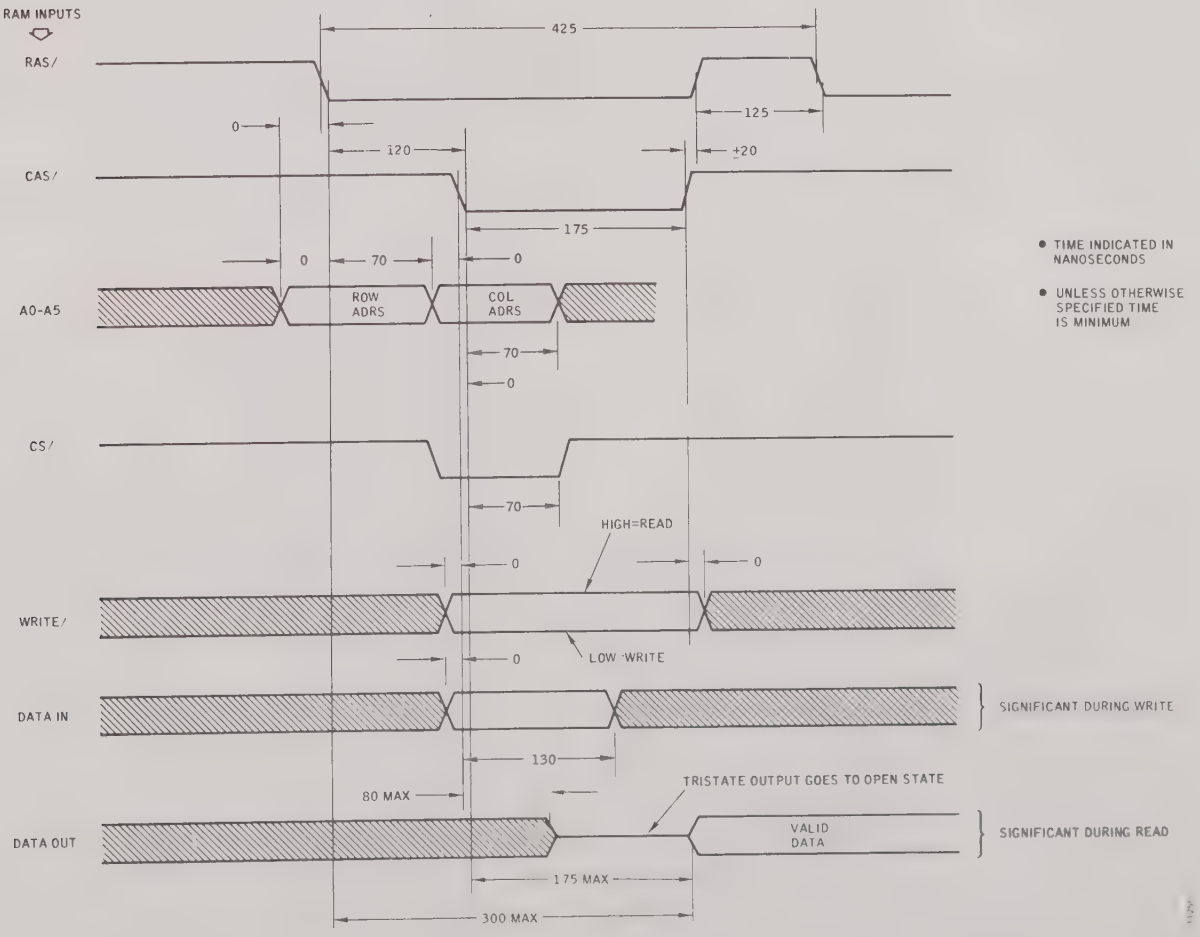


Figure 3-8. RAM Timing Tolerances

5. Read out every memory location.
   - Starting at location zero, enter:

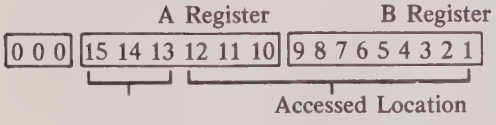
     260 BOM
     000 POINTER
     000
     000 HALT
   - Set the A register to
     760 if 8K memory.
     740 if 16K memory.
     720 if 24K memory.
     700 if 32K memory.
   - Set the B register to zero.
   - Set PROGRAM COUNT to zero.
   - Press MASTER CLEAR if the PARITY indicator is on.
   - Press EXECUTE (or RUN).

6. If the PARITY indicator does not light and the PROGRAM COUNT display indicates 0004, proceed to the Soft Failure procedure.

7. Press MASTER CLEAR.

8. Set the PARITY TEST switch to normal (down).

9. Examine the contents of the A and B registers, which contain the address of the location where the read parity error occurred.



000	1st 4K	Module No. 1
001	2nd 4K	
010	3rd 4K	Module No. 1
011	4th 4K	
100	5th 4K	Module No. 3
101	6th 4K	
110	7th 4K	Module No. 4
111	8th 4K	

10. Using the Data Entry Switches, enter the address in the A and B registers into the P register. Examine the contents of memory.
    - If the PARITY indicator does not light again, proceed to the Soft Failure procedure.
    - If the contents of this location is not zero, try clearing the nonzero bit(s) manually.
    - If the contents of this location is zero, the parity bit is the probable problem.

Soft Failure

Soft Failures are defined as those that do not occur consistently in time. One must establish whether the point of failure is consistent or random by keeping a record of all pertinent panel indications. In many instances, while results may seem random, a recognizable failure pattern may form and can often point to the problem. Outlined below is a generalized procedure to isolate soft errors.

1. Place the parity test switch on the memory MIB to the test position (up), and press MASTER CLEAR.

2. Load the diagnostic or operating system program gram causing the parity error.

3. When the program stops with the PARITY indicator on, press MASTER CLEAR and record the program count.

4. Monitor the memory address lines at the CPU/Memory MIB:

MA01,J10-A36	MA09,J10-A21
MA02,J10-A38	MA10,J10-A31
MA03,J10-A21	MA11,J10-A34
MA04,J10-A30	MA12,J10-A35
MA05,J10-A02	MA13,J9-B29
MA06,J10-A03	MA14,J9-B30
MA07,J10-A17	MA15,J9-A31
MA08,J10-B28	

5. Refer to the program listing, and check the contents of the address recorded in Step 3.
   - If the location is not used by the program, there may be an address problem.
   - If the location is used, correlate the program count recorded in Step 3 with the address, and compare the contents of that location with the program listing.

6. Repeat the procedure above until a reasonable data sample is accumulated. If results are totally random, recheck timing and interface signals, and check pins of connectors mating with 8K modules. If the memory addreses seem to fall outside of program areas within the memory, there may be CPU address problems.

SECTION 4

BLOCK AND LOGIC DIAGRAMS

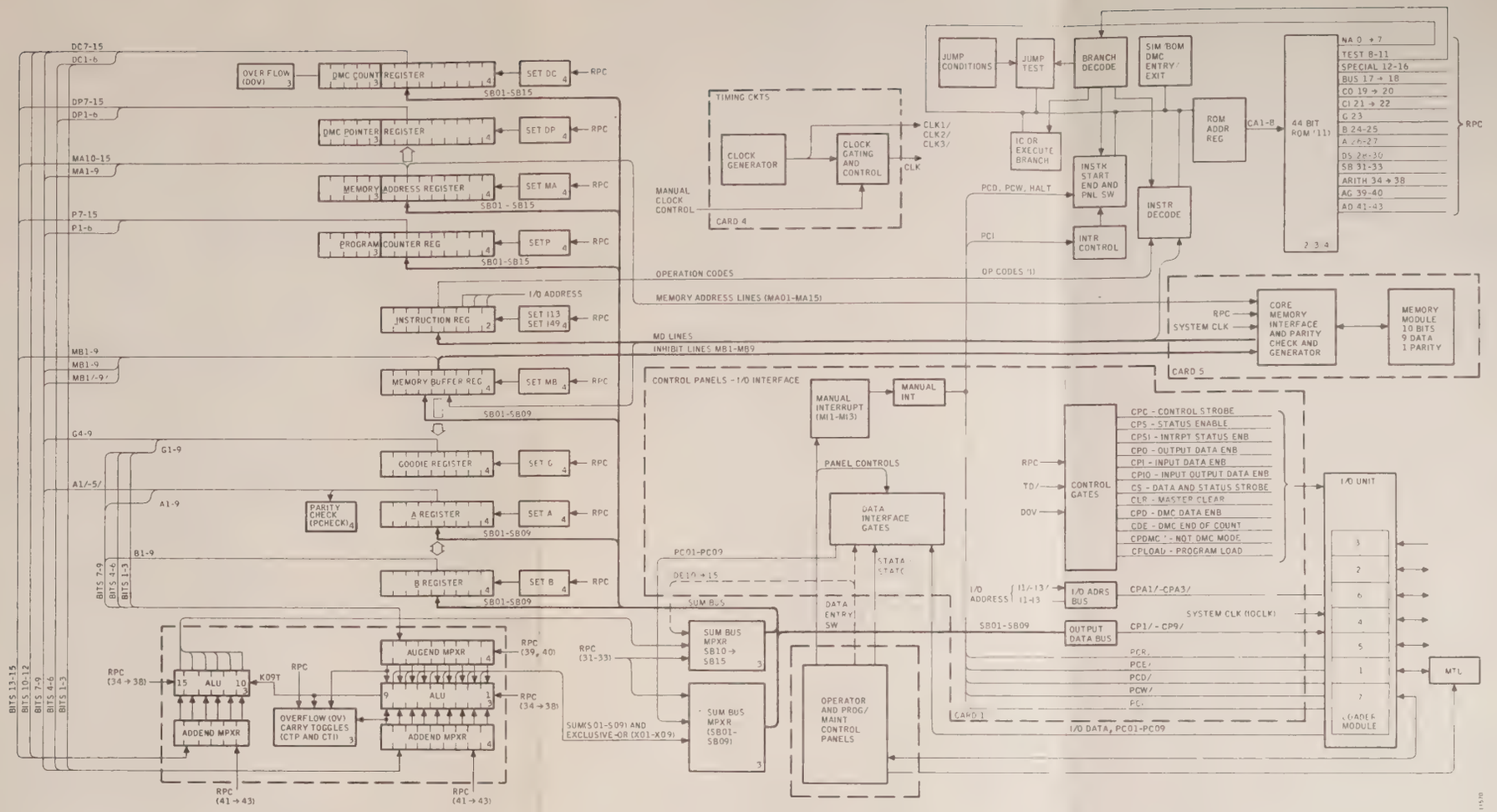
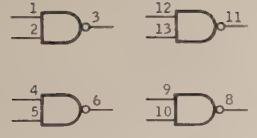
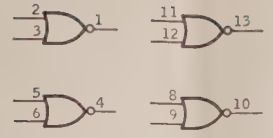


Figure 4-1. CPU Block Diagram



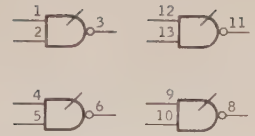
GRD - 7
V_{CC} - 14

SN74S00, SN74LS00
QUAD 2-INPUT NAND GATE



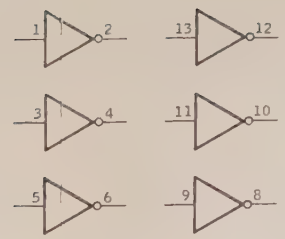
GRD - 7
V_{CC} - 14

SN74LS02
QUAD 2-INPUT NOR GATE



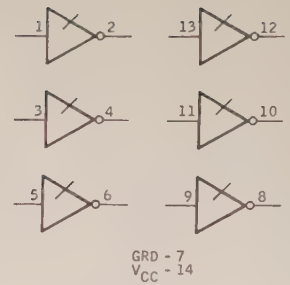
GRD - 7
V_{CC} - 14

SN74LS03
QUAD 2-INPUT OPEN-COLLECTOR NAND GATE



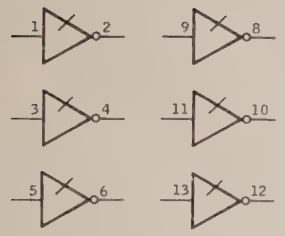
GRD - 7
V_{CC} - 14

SN74S04, SN74LS04
HEX INVERTER



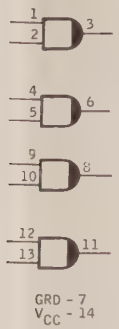
GRD - 7
V_{CC} - 14

SN74S05, SN74LS05
HEX OPEN-COLLECTOR INVERTER



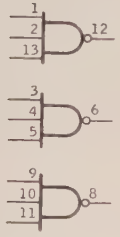
GRD - 7
V_{CC} - 14

SN7406
HEX OPEN-COLLECTOR INVERTER



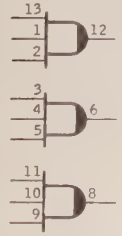
GRD - 7
V_{CC} - 14

SN74S08, SN74LS08
QUAD 2-INPUT AND GATE



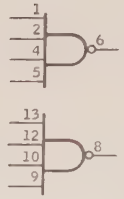
GRD - 7
V_{CC} - 14

SN74S10, SN74LS10
TRIPLE 3-INPUT NAND GATE



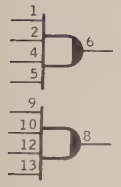
V_{CC} - 14
GRD - 7

SN74S11
SN74LS11
TRIPLE 3-INPUT
POSITIVE-AND GATES



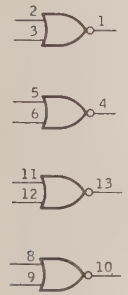
GRD - 7
V_{CC} - 14
NC - 3,11

SN74S20
DUAL 4-INPUT NAND GATE



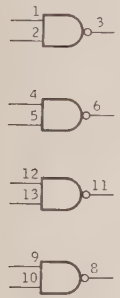
GRD - 7
V_{CC} - 14
NC - 3, 11

SN74H21
DUAL 4-INPUT AND GATE



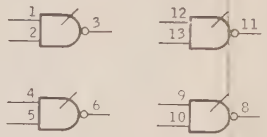
V_{CC} - 14
GRD - 7

SN7428
QUADRUPLE 2-INPUT
POSITIVE-NOR BUFFERS



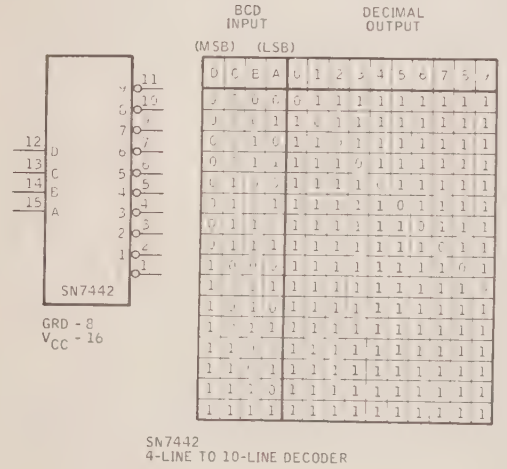
V_{CC} - 14
GRD - 7

SN7437
QUADRUPLE 2-INPUT
POSITIVE-NAND BUFFERS



V_{CC} - 14
GRD - 7

SN7438
QUADRUPLE 2-INPUT POSITIVE-NAND
BUFFERS WITH OPEN-COLLECTOR OUTPUTS

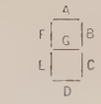


GRD - 8
V_{CC} - 16

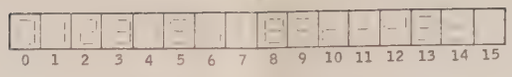
SN7442
4-LINE TO 10-LINE DECODER

11256

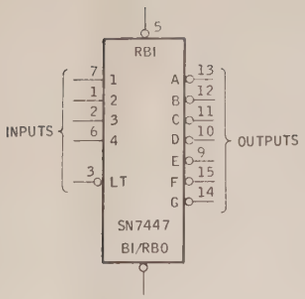
Figure 4-2. Chip Dictionary (Sheet 1)



SEGMENT
INDENTIFICATION



NUMERICAL DESIGNATIONS AND RESULTANT DISPLAYS



GRD-8
V_{CC}-16

FUNCTION TABLE

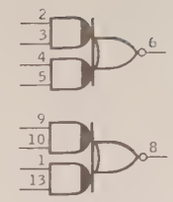
DECIMAL OR FUNCTION	INPUTS LT	RBI	4	3	2	1	BI/RBO*	OUTPUTS A	B	C	D	E	F	G	NOTE
0	H	H	L	L	L	L	H	ON	ON	ON	ON	ON	ON	OFF	
1	H	X	L	L	L	H	H	OFF	ON	ON	OFF	OFF	OFF	OFF	
2	H	X	L	L	H	L	H	ON	ON	OFF	ON	ON	OFF	ON	
3	H	X	L	L	H	H	H	ON	ON	ON	ON	OFF	OFF	ON	
4	H	X	L	H	L	L	H	OFF	ON	ON	OFF	OFF	ON	ON	
5	H	X	L	H	L	H	H	ON	OFF	ON	ON	OFF	ON	ON	
6	H	X	L	H	H	L	H	OFF	OFF	ON	ON	ON	ON	ON	
7	H	X	L	H	H	H	H	ON	ON	ON	OFF	OFF	OFF	OFF	1
8	H	X	H	L	L	L	H	ON	ON	ON	ON	ON	ON	ON	
9	H	X	H	L	L	H	H	ON	ON	ON	OFF	OFF	ON	ON	
10	H	X	H	L	H	L	H	OFF	OFF	OFF	ON	ON	OFF	ON	
11	H	X	H	L	H	H	H	OFF	OFF	ON	ON	OFF	OFF	ON	
12	H	X	H	H	L	L	H	OFF	ON	OFF	OFF	OFF	ON	ON	
13	H	X	H	H	L	H	H	ON	OFF	OFF	ON	OFF	ON	ON	
14	H	X	H	H	H	L	H	OFF	OFF	OFF	ON	ON	OFF	ON	
15	H	X	H	H	H	H	H	OFF	OFF	OFF	OFF	OFF	OFF	OFF	
BI	X	X	X	X	X	X	L	OFF	OFF	OFF	OFF	OFF	OFF	OFF	2
RBI	H	L	L	L	L	L	L	OFF	OFF	OFF	OFF	OFF	OFF	OFF	3
LT	L	X	X	X	X	X	H	ON	ON	ON	ON	ON	ON	ON	4

H = HIGH LEVEL, L = LOW LEVEL, X = IRRELEVANT

NOTES:
1. THE BLANKING INPUT (BI) MUST BE OPEN OR HELD AT A HIGH LOGIC LEVEL WHEN OUTPUT FUNCTIONS 0 THROUGH 15 ARE DESIRED. THE RIPPLE-BLANKING INPUT (RBI) MUST BE OPEN OR HIGH IF BLANKING OF A DECIMAL ZERO IS NOT DESIRED.
2. WHEN A LOW LOGIC LEVEL IS APPLIED DIRECTLY TO THE BLANKING INPUT (BI), ALL SEGMENT OUTPUTS ARE OFF REGARDLESS OF THE LEVEL OF ANY OTHER INPUT.
3. WHEN RIPPLE-BLANKING INPUT (RBI) AND INPUTS A, B, C, AND D ARE AT A LOW LEVEL WITH THE LAMP TEST INPUT HIGH, ALL SEGMENT OUTPUTS GO OFF AND THE RIPPLE-BLANKING OUTPUT (RBO) GOES TO A LOW LEVEL (RESPONSE CONDITION).
4. WHEN THE BLANKING INPUT/RIPPLE BLANKING OUTPUT (RBI/RBO) IS OPEN OR HELD HIGH AND A LOW IS APPLIED TO THE LAMP-TEST INPUT, ALL SEGMENT OUTPUTS ARE ON.

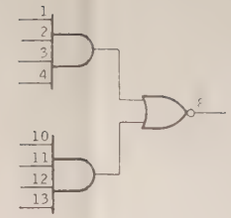
*BI/RBO IS WIRE-AND LOGIC SERVING AS BLANKING INPUT (BI) AND/OR RIPPLE-BLANKING OUTPUT (RBO)

SN7447
BCD-TO-SEVEN-SEGMENT DECODER/DRIVERS



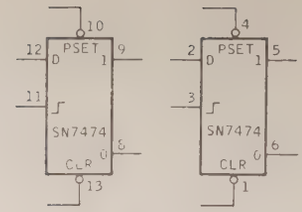
GRD - 7
V_{CC} - 14
NC - 11, 12

SN74LS51
DUAL 2-INPUT
AND-OR-INVERT GATE



V_{CC} - 14
GRD - 7

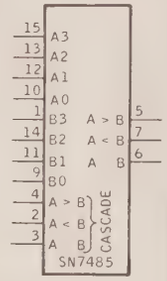
SN74H55
2-WIDE 4-INPUT AND-
OR-INVERT GATES



GRD - 7
V_{CC} - 14

t_n	$t_n + 1$	
INPUT D	OUTPUT 1	OUTPUT 0
L	L	H
H	H	L

SN74S74
DUAL D-TYPE EDGE-TRIGGERED FLIP-FLOP

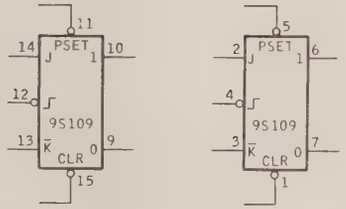


OUTPUT (A > B) HIGH WHEN WORD A, THE NUMBER A3 A2 A1 A0, IS GREATER THAN WORD B, THE NUMBER B3 B2 B1 B0, OR WHEN WORD A EQUALS WORD B AND CASCADE INPUT (A > B) IS HIGH.

OUTPUT (A < B) HIGH WHEN WORD A IS LESS THAN WORD B OR WHEN WORD A EQUALS WORD B AND CASCADE INPUT (A < B) IS HIGH.

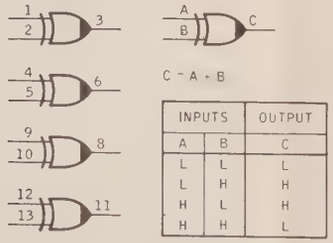
OUTPUT (A = B) HIGH WHEN WORD A EQUALS WORD B AND CASCADE INPUT (A = B) IS HIGH.

SN74LS85
4-BIT MAGNITUDE COMPARATOR



V_{CC} - 16
GRD - 8

SN74LS109
DUAL J-$\bar{K}$ POSITIVE-EDGE-TRIGGERED
FLIP-FLOPS WITH PRESET AND CLEAR

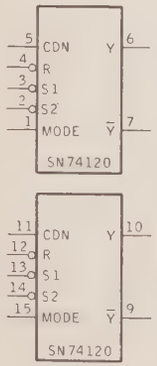


C = A • B

INPUTS A	INPUTS B	OUTPUT C
L	L	L
L	H	H
H	L	H
H	H	L

GRD - 7
V_{CC} - 14

SN74H86
QUAD 2-INPUT EXCLUSIVE-OR GATE



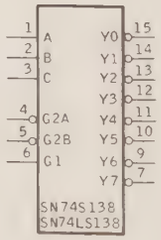
V_{CC} - 16
GRD - 8

FUNCTION TABLE

R	S1	S2	FUNCTION
X	L	X	PASS OUTPUT PULSES
X	X	L	PASS OUTPUT PULSES
L	H	H	INHIBIT OUTPUT PULSES
H	↓	H	START OUTPUT PULSES
H	H	↓	START OUTPUT PULSES
↓	H	H	STOP OUTPUT PULSES
H	H	H	CONTINUE OPERATION INITIATED BY LAST ↓ TRANSITION

H = HIGH LEVEL (STEADY STATE)
L = LOW LEVEL (STEADY STATE)
↓ = TRANSITION FROM H TO L
X = IRRELEVANT

SN74120
DUAL PULSE SYNCHRONIZER/DRIVER



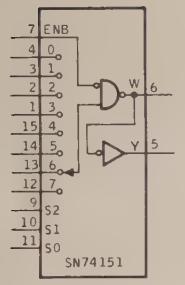
OCTAL VALUE ON INPUT (CBA) DESIGNATES WHICH OUTPUT LINE (Y0 - Y7) IS SET LOW. OUTPUTS ARE ENABLED BY G1 HIGH • G2A LOW • G2B LOW

V_{CC} - 16
GRD - GRD

SN74S138, SN74LS138
3-TO-8 LINE DECODER

11257

Figure 4-2. Chip Dictionary (Sheet 2)



GRD - 8
V_{CC} - 16

INPUTS												OUTPUTS	
S2	S1	S0	ENB	0	1	2	3	4	5	6	7	Y	W
X	X	X	H	X	X	X	X	X	X	X	X	L	H
L	L	L	L	L	X	X	X	X	X	X	X	L	H
L	L	L	L	H	X	X	X	X	X	X	X	H	L
L	L	H	L	X	L	X	X	X	X	X	X	L	H
L	L	H	L	X	H	X	X	X	X	X	X	H	L
L	H	L	L	X	X	L	X	X	X	X	X	L	H
L	H	L	L	X	X	H	X	X	X	X	X	H	L
L	H	H	L	X	X	X	L	X	X	X	X	L	H
L	H	H	L	X	X	X	H	X	X	X	X	H	L
H	L	L	L	X	X	X	X	L	X	X	X	L	H
H	L	L	L	X	X	X	X	H	X	X	X	H	L
H	L	H	L	X	X	X	X	X	L	X	X	L	H
H	L	H	L	X	X	X	X	X	H	X	X	H	L
H	H	L	L	X	X	X	X	X	X	L	X	L	H
H	H	L	L	X	X	X	X	X	X	H	X	H	L
H	H	H	L	X	X	X	X	X	X	X	L	L	H
H	H	H	L	X	X	X	X	X	X	X	H	H	L

H = HIGH LEVEL, L = LOW LEVEL, X = IRRELEVANT

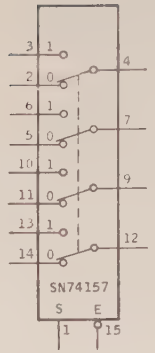
SN74LS151
DATA SELECTOR/MULTIPLEXER

GRD - 8
V_{CC} - 16

SELECT INPUTS		DATA INPUTS				ENABLE	OUTPUT
S1	S0	0	1	2	3		
X	X	X	X	X	X	H	L
L	L	L	X	X	X	L	L
L	L	H	X	X	X	L	H
L	H	X	L	X	X	L	L
L	H	X	H	X	X	L	H
H	L	X	X	L	X	L	L
H	L	X	X	H	X	L	H
H	H	X	X	X	L	L	L
H	H	X	X	X	H	L	H

ADDRESS INPUTS S0 AND S1 ARE COMMON TO BOTH SECTIONS.
H = HIGH LEVEL, L = LOW LEVEL, X = IRRELEVANT

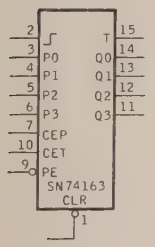
SN74S153, SN74LS153
DUAL 4-LINE-TO-1-LINE DATA SELECTOR/MULTIPLEXER



GRD - 8
V_{CC} - 16

ENABLE	SELECT INPUT	INPUTS		OUTPUT
E	S	0	1	
H	X	X	X	L
L	L	L	X	L
L	L	H	X	H
L	H	X	L	L
L	H	X	H	H

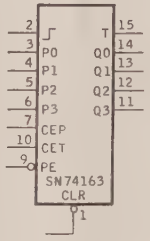
SN74LS157
QUAD 2-INPUT MULTIPLEXER



PARALLEL ENABLE (PE LOW)
P0 → Q0
P1 → Q1
P2 → Q2
P3 → Q3
OUTPUTS AFTER FIRST CLOCK
COUNT 0 → 15 = CET · CEP
INHIBIT COUNT = CET/ + CEP/
CARRY OUTPUT
T = CET · COUNT 15

GRD - 8
V_{CC} - 16

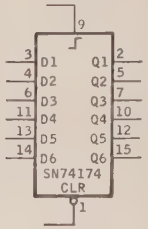
SN74S163
BINARY COUNTER



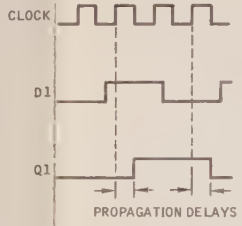
PARALLEL ENABLE (PE LOW)
P0 → Q0
P1 → Q1
P2 → Q2
P3 → Q3
OUTPUTS AFTER FIRST CLOCK
COUNT 0 → 15 = CET · CEP
INHIBIT COUNT = CET/ + CEP/
CARRY OUTPUT
T = CET · COUNT 15

GRD - 8
V_{CC} - 16

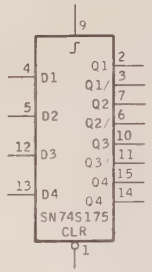
SN74161, SN74161N
BINARY COUNTER



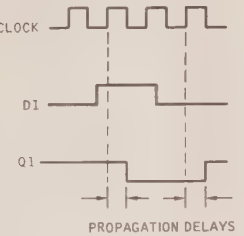
GRD - 8
V_{CC} - 16



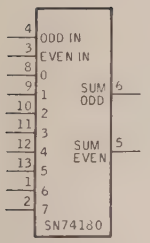
SN74LS174
HEX D-TYPE FLIP-FLOP



V_{CC} - 16
GRD - 8



SN74175, SN74S175
QUAD D-TYPE FLIP-FLOP

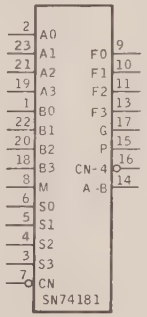


GRD - 7
V_{CC} - 14

INPUTS			OUTPUTS	
SUM OF 1's AT 0 THRU 7	EVEN	ODD	SUM EVEN	SUM ODD
EVEN	H	L	H	L
ODD	H	L	L	H
EVEN	L	H	L	H
ODD	L	H	H	L
X	H	H	L	L
X	L	L	H	H

H = HIGH LEVEL, L = LOW LEVEL,
X = IRRELEVANT

SN74180
8-BIT ODD/EVEN PARITY GENERATOR/CHECKER



GRD - 12
V_{CC} - 24

DESIGNATION	FUNCTION
A3, A2, A1, A0	WORD A INPUTS
B3, B2, B1, B0	WORD B INPUTS
S3, S2, S1, S0	FUNCTION-SELECT INPUTS
CN	CARRY INPUT
M	MODE CONTROL INPUT
F3, F2, F1, F0	FUNCTION OUTPUTS
A = B	COMPARATOR OUTPUT
P	CARRY PROPAGATE OUTPUT
CN + 4	CARRY OUTPUT
G	CARRY GENERATE OUTPUT
VCC	SUPPLY VOLTAGE
GRD	GROUND

SELECTION				ACTIVE HIGH DATA		
				M = H LOGIC FUNCTIONS	M = L: ARITHMETIC OPERATIONS	
S3	S2	S1	S0		CN = 0	CN = 1
L	L	L	L	F = A/	F = A	F = A PLUS 1
L	L	L	H	F = A/ B/	F = A + B	F = (A + B) PLUS 1
L	L	H	L	F = A/ B	F = A + B/	F = (A + B/) PLUS 1
L	L	H	H	F = 0	F = MINUS 1 (2's COMPL)	F = 0
L	H	L	L	F = A/ + B/	F = A PLUS AB/	F = A PLUS AB/ PLUS 1
L	H	L	H	F = B/	F = (A + B) PLUS AB/	F = (A + B) PLUS AB/ PLUS 1
L	H	H	L	F = A ⊕ B	F = A MINUS B MINUS 1	F = A MINUS B
L	H	H	H	F = AB/	F = AB/ MINUS 1	F = AB/
H	L	L	L	F = A/ + B	F = A PLUS AB	F = A PLUS AB PLUS 1
H	L	L	H	F = (A ⊕ B)/	F = A PLUS B	F = A PLUS B PLUS 1
H	L	H	L	F = B	F = (A + B/) PLUS AB	F = (A + B/) PLUS AB PLUS 1
H	L	H	H	F = AB	F = AB MINUS 1	F = AB
H	H	L	L	F = 1	F = A PLUS A *	F = A PLUS A PLUS 1
H	H	L	H	F = A + B/	F = (A + B) PLUS A	F = (A + B) PLUS A PLUS 1
H	H	H	L	F = A + B	F = (A + B/) PLUS A	F = (A + B/) PLUS A PLUS 1
H	H	H	H	F = A	F = A MINUS 1	F = A

* EACH BIT IS SHIFTED TO THE NEXT MORE SIGNIFICANT POSITION

SN74S181
ARITHMETIC LOGIC UNIT/FUNCTION GENERATOR (ACTIVE - HIGH DATA)

11238

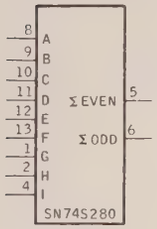
Figure 4-2. Chip Dictionary (Sheet 3)

V_{CC} - 16
GRD - 8

CN+X = G0/ + P0/CN
CN+Y = G1/ + P1/G0/ + P1/P0/CN
CN+Z = G2/ + P2/G1/ + P2/P1/G0/ + P2/P1/P0/CN
G/ = G3/(P3/ + P2/)(P3/ + P2/ + G1/)
(P3/ + P2/ + P1/ + G0/)
P/ = P3/P2/P1/P0/

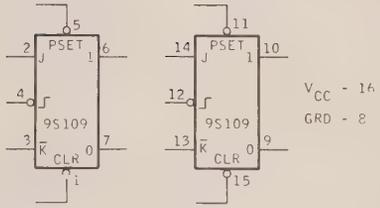
SN74S182
LOOK-AHEAD CARRY GENERATOR

POLARITY OF RESPECTIVE OUTPUT INDICATES THAT NUMBER OF INPUTS WITH THAT POLARITY IS ODD OR EVEN



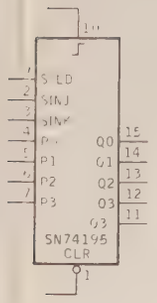
V_{CC} - 14
GRD - 7

SN74S280
9-BIT ODD EVEN PARITY GENERATOR/CHECKER



V_{CC} - 16
GRD - 8

9S109
DUAL J-$\overline{K}$ POSITIVE-EDGE-TRIGGERED FLIP-FLOPS WITH PRESET AND CLEAR



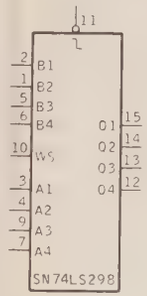
SHIFT (Q0 TOWARD Q3)
S/LD HIGH WITH CLOCK
PARALLEL LOAD - S/LD LOW
P0 → Q0
P1 → Q1
P2 → Q2
P3 → Q3
OUTPUTS WITH CLOCK
SERIAL DATA - S/LD HIGH

INPUTS AT TN		OUTPUTS AT TN-1				
SINJ	SINK	Q0	Q1	Q2	Q3	Q3
L	H	Q0N	Q0N	Q1N	Q2N	(Q2N)
L	L	L	Q0N	Q1N	Q2N	(Q2N)
H	H	H	Q0N	Q1N	Q2N	(Q2N)
H	L	(Q0N)/	Q0N	Q1N	Q2N	(Q2N)

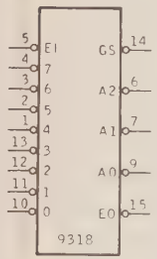
TN - BIT TIME BEFORE CLOCK PULSE
TN+1 = BIT TIME AFTER CLOCK PULSE
Q(X)N - STATE OF Q(X) AT TN

GRD - 8
V_{CC} - 16

SN74LS195
4-BIT PARALLEL-ACCESS SHIFT REGISTER



SN74S298,
SN74LS298
QUAD, 2-INPUT MULTIPLEXERS WITH STORAGE
INPUT INFORMATION TRANSFERRED TO OUTPUT ON NEGATIVE GOING EDGE OF CLOCK. B INPUT IS SELECTED WHEN WORD SELECT (WS) INPUT IS HIGH



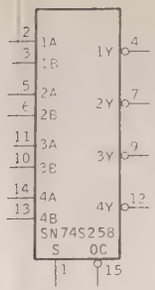
EI = ENABLE INPUT
0-7 = PRIORITY INPUTS
GS = GROUP SELECT
EO = ENABLE OUTPUT
A0-A2 = ADDRESS OUTPUTS

EI	0	1	2	3	4	5	6	7	GS	A0	A1	A2	EO
H	X	X	X	X	X	X	X	X	H	H	H	H	H
L	H	H	H	H	H	H	H	H	H	H	H	H	L
L	X	X	X	X	X	X	X	L	L	L	L	L	H
L	X	X	X	X	X	X	L	H	L	H	L	L	H
L	X	X	X	X	X	L	H	H	L	L	H	L	H
L	X	X	X	X	L	H	H	H	L	H	H	L	H
L	X	X	X	L	H	H	H	H	L	L	L	H	H
L	X	X	L	H	H	H	H	H	L	H	L	H	H
L	X	L	H	H	H	H	H	H	L	L	H	H	H
L	L	H	H	H	H	H	H	H	L	H	H	H	H

VCC - 16
GRD - 8

H = HIGH VOLTAGE LEVEL
L = LOW VOLTAGE LEVEL
X = IRRELEVANT

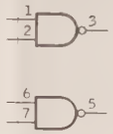
9318
8-INPUT PRIORITY ENCODER



OUTPUTS ARE AT HIGH IMPEDANCE (Z) WHEN DISABLED. LOW ON OC ENABLES OUTPUTS. SELECTED INPUTS ARE INVERTED AT OUTPUT. LOW ON S SELECTS A INPUTS

V_{CC} - 16
GRD - 8

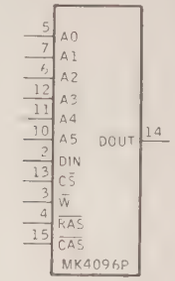
SN74S258
QUAD 2-TO-1 LINE DATA SELECTORS/MULTIPLEXERS WITH 3-STATE OUTPUT



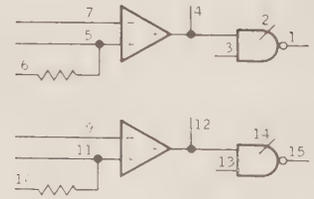
V_{CC} - 8
GRD - 4

SN75452BP
8 PIN CHIP

DIN = DATA IN
CS = CHIP SELECT
W = WRITE
RAS = ROW ADDRESS SELECT
CAS = COLUMN ADDRESS SELECT
A0 - A5 = ADDRESS
DOUT = DATA OUT



MK4096P



V_{CC} - 16
GRD - 8

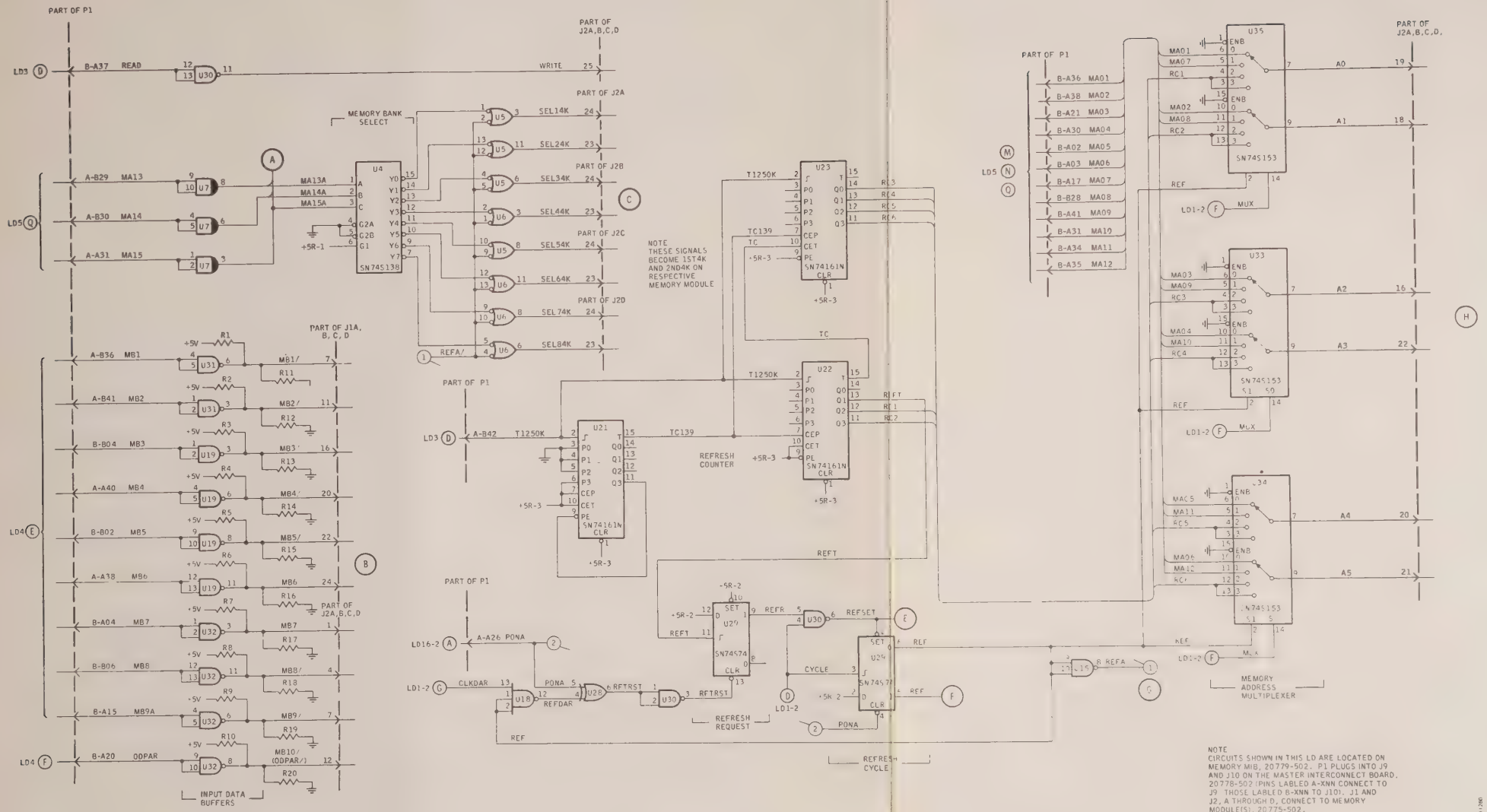
9615
DUAL DIFFERENTIAL LINE RECEIVER

11259

Figure 4-2. Chip Dictionary (Sheet 4)

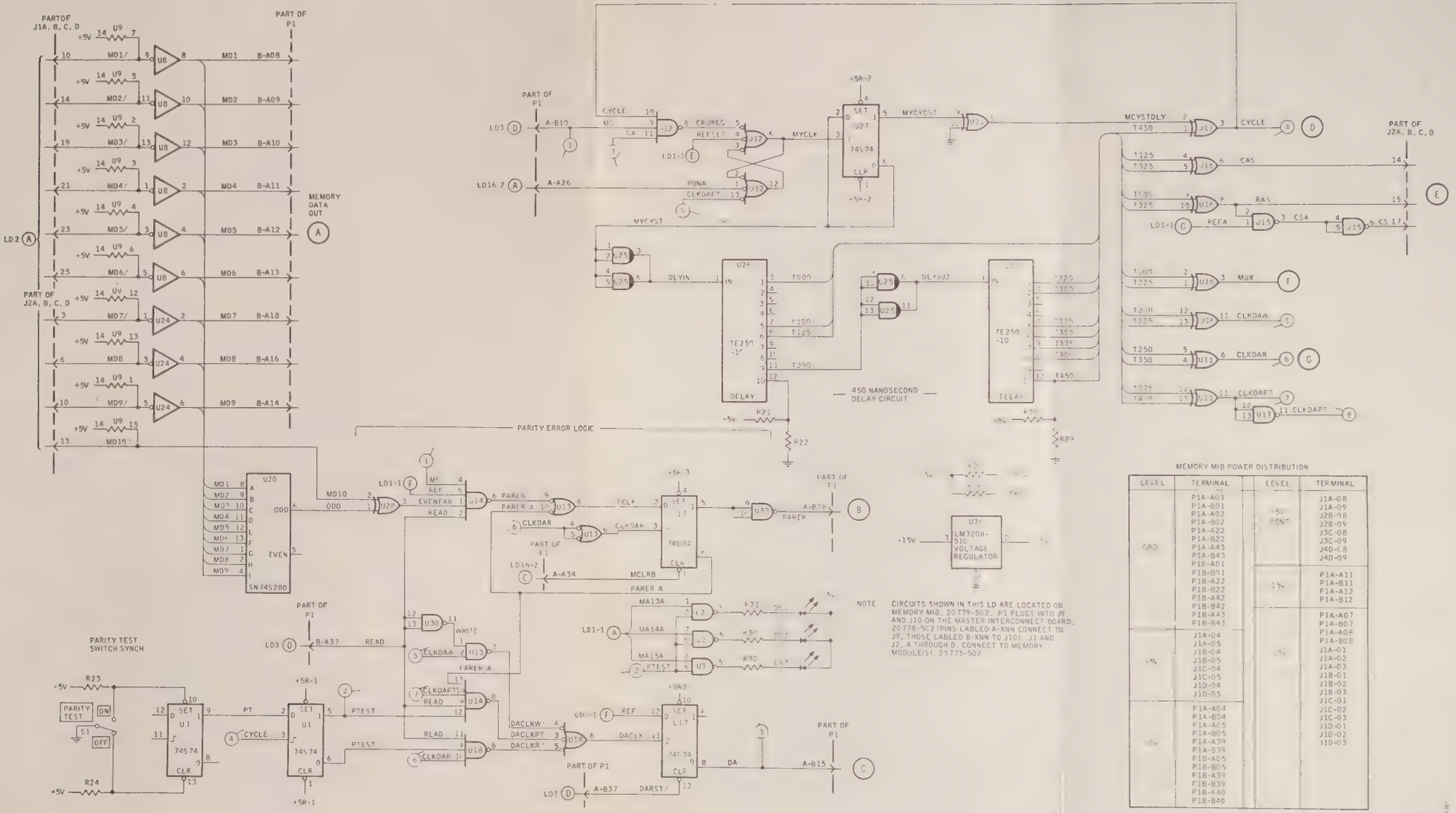
SIGNAL OUTPUT LIST FOR LD1-1

Output	Destination	Memory Address Multiplexer Functions		
		S1	S0	Function
1ST4K	LD2	0	0	MA1-6 = Row
2ND4K	LD2	0	1	MA7-15 = Col
A0-A5	LD2	1	0	Refresh Row
MB1/-MB10/	LD2	1	1	Refresh Row
REFA/	LD1-2			
REFSET/	LD1-2			
REF/	LD1-2			
WRITE	LD2			



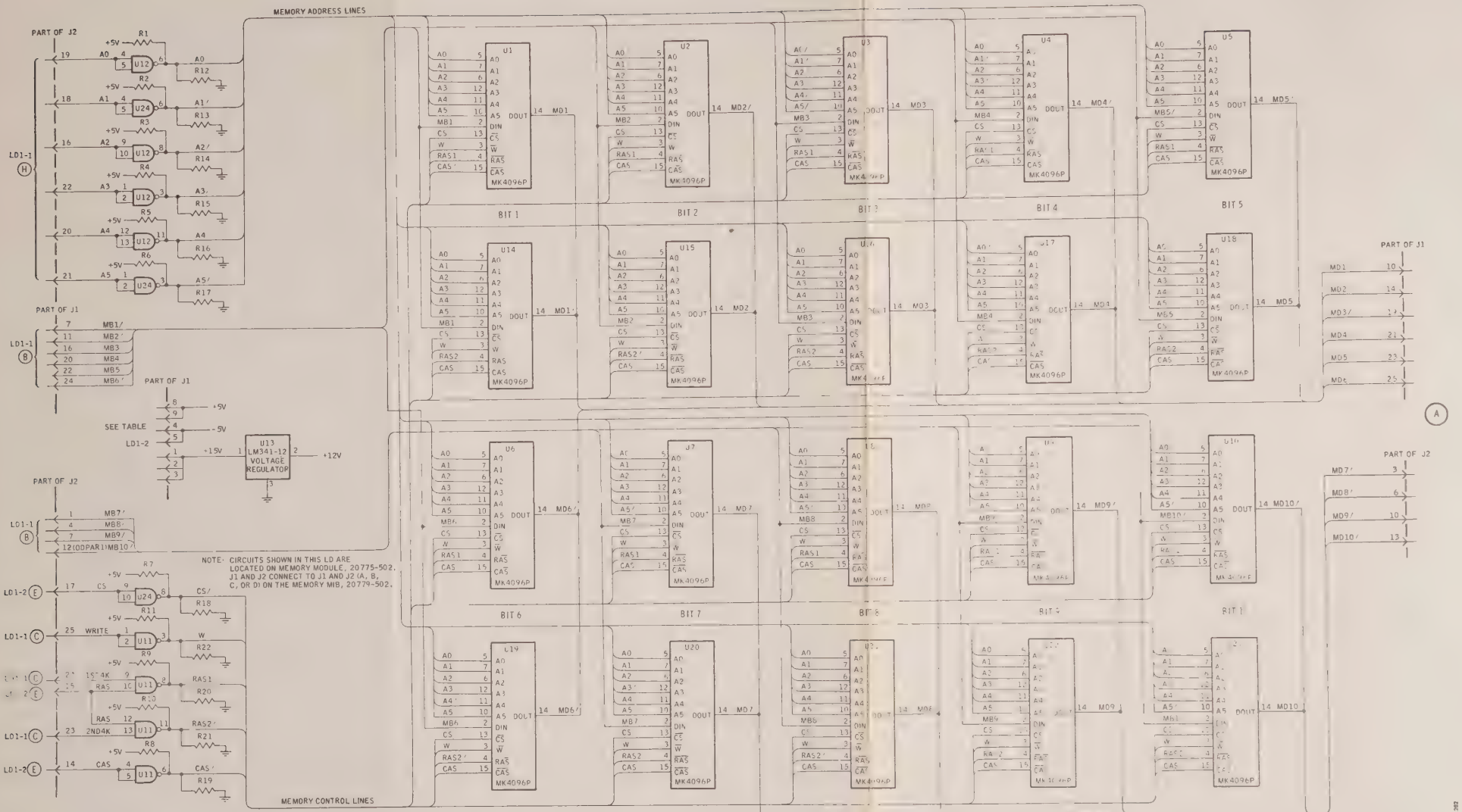
SIGNAL OUTPUT LIST FOR LD1-2

Output	Destination	Output	Destination
CAS	LD2	MUX	LD1-1
CLKDAR	LD1-1	PARER/	LD16-2
CS	LD2	RAS	LD2
CYCLE/	LD1-1		
DA/	LD3		
MD1-MD9	LD4, LD11, LD12	Note: Delay timing waveform is shown in Figure 3-3.	



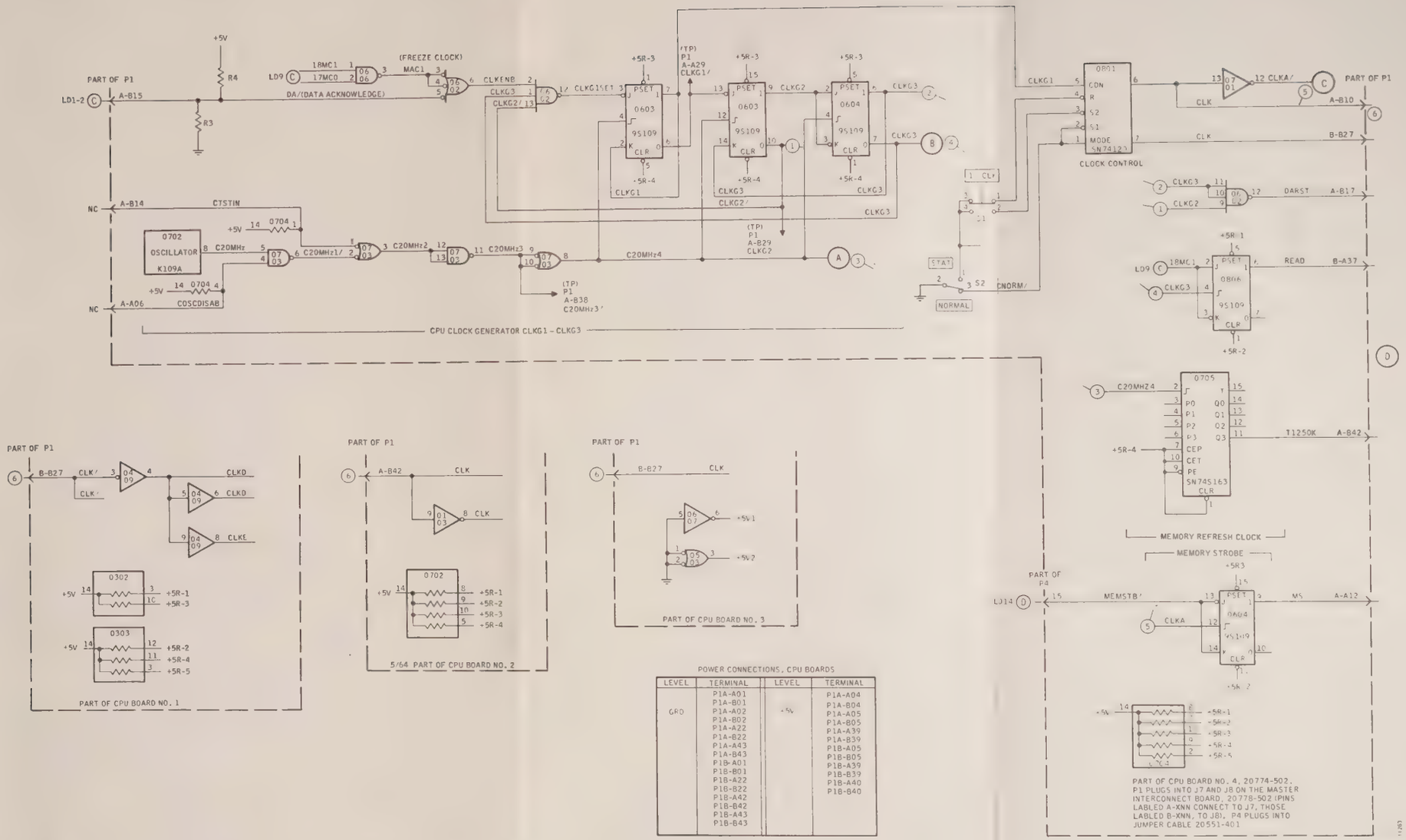
SIGNAL OUTPUT LIST FOR LD2

Output	Destination
MD1/-MD10/	LD1-2



SIGNAL OUTPUT LIST FOR LD3

Output	Destination
DARST/	LD1-2
MS	LD1-2
READ	LD1-1, LD1-2
T1250K	LD1-1



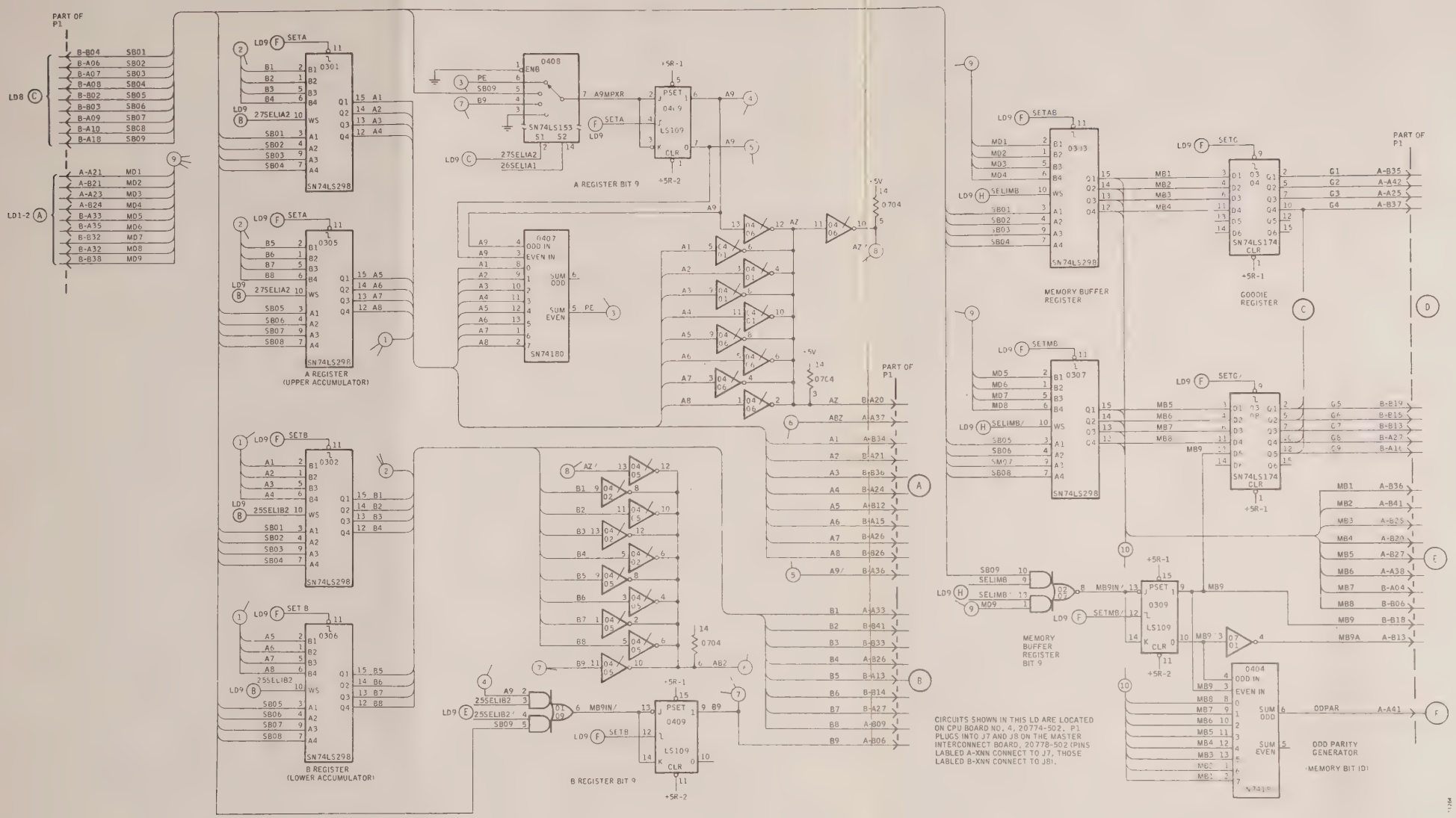
POWER CONNECTIONS, CPU BOARDS

LEVEL	TERMINAL	LEVEL	TERMINAL
GRD	P1A-A01 P1A-B01 P1A-A02 P1A-B02 P1A-A22 P1A-B22 P1A-A43 P1A-B43 P1B-A01 P1B-B01 P1B-A22 P1B-B22 P1B-A42 P1B-B42 P1B-A43 P1B-B43	+5V	P1A-A04 P1A-B04 P1A-A05 P1A-B05 P1A-A39 P1A-B39 P1B-A05 P1B-B05 P1B-A39 P1B-B39 P1B-A40 P1B-B40

LD3

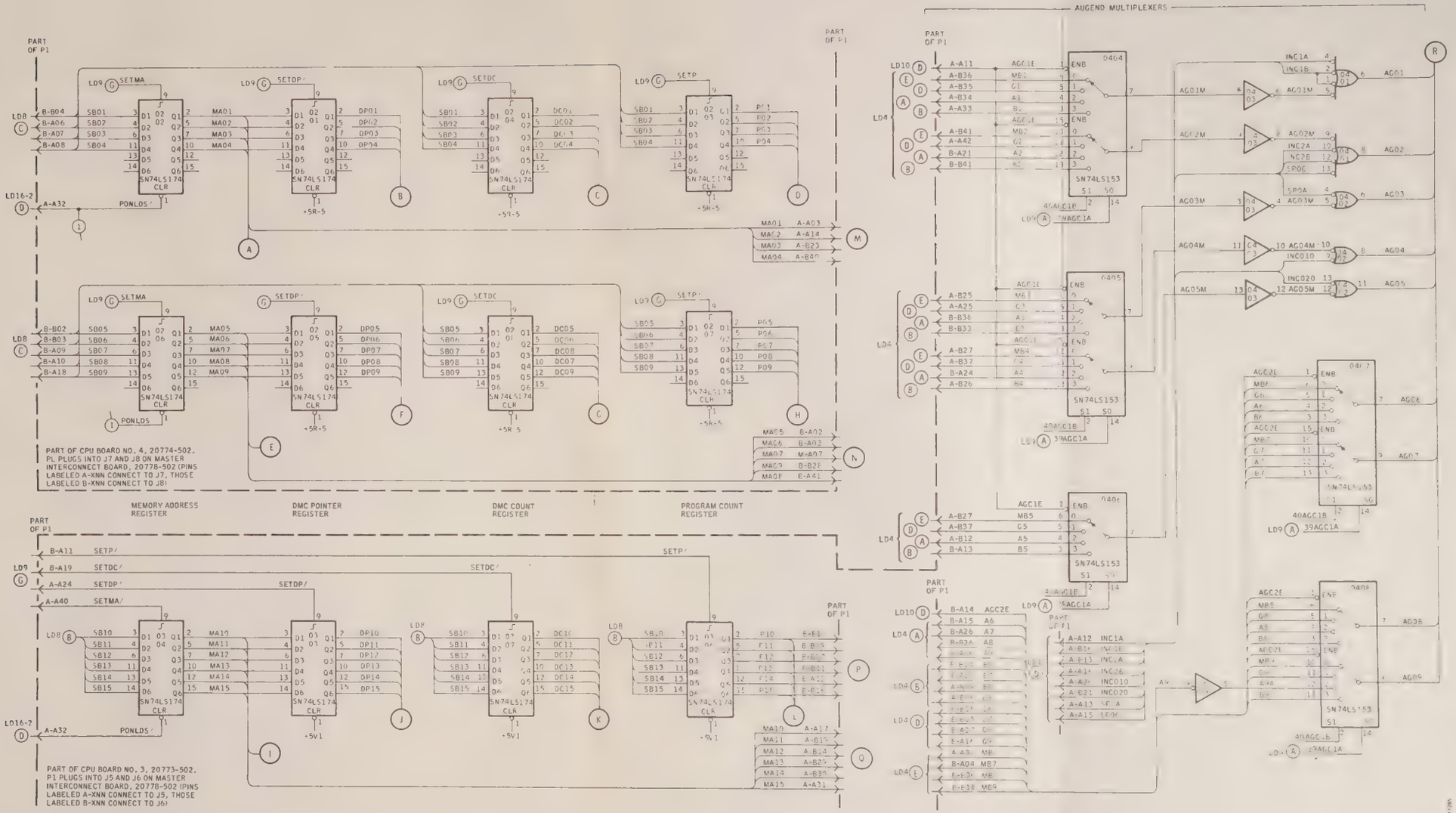
SIGNAL OUTPUT LIST FOR LD4

Output	Destination	Output	Destination
A1	LD5, LD6, LD8, LD13, LD17	G1-G3	LD5
A2-A8	LD5, LD6, LD8, LD17	G4-G9	LD5, LD6
A9	LD6, LD17	MB1-MB6	LD1-1, LD5, LD6, LD17
A9/	LD5, LD6, LD8	MB7, MB8	LD1-1, LD5, LD6, LD8, LD17
AZ	LD13	MB9	LD5, LD6, LD8
B1	LD13	MB9A	LD1-1, LD17
B2-B9	LD5, LD6, LD8	ODPAR	LD1-1



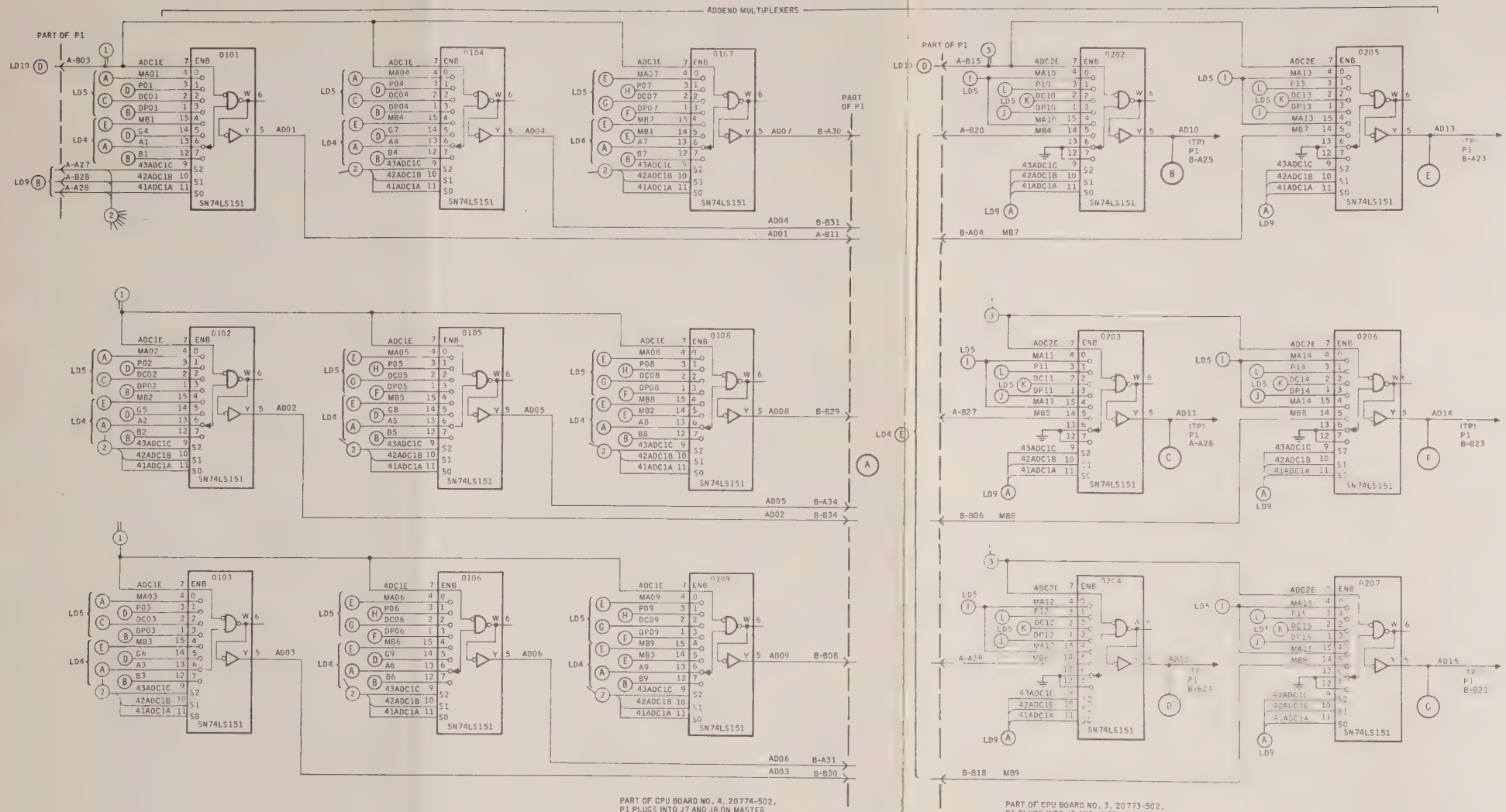
SIGNAL OUTPUT LIST FOR LD5

Output	Destination
AG01-AG09	LD7
DC01-DC15	LD6
PD01-PD15	LD6
MA01-MA15	LD1-1, LD6, LD15, LD17
P01-P15	LD6



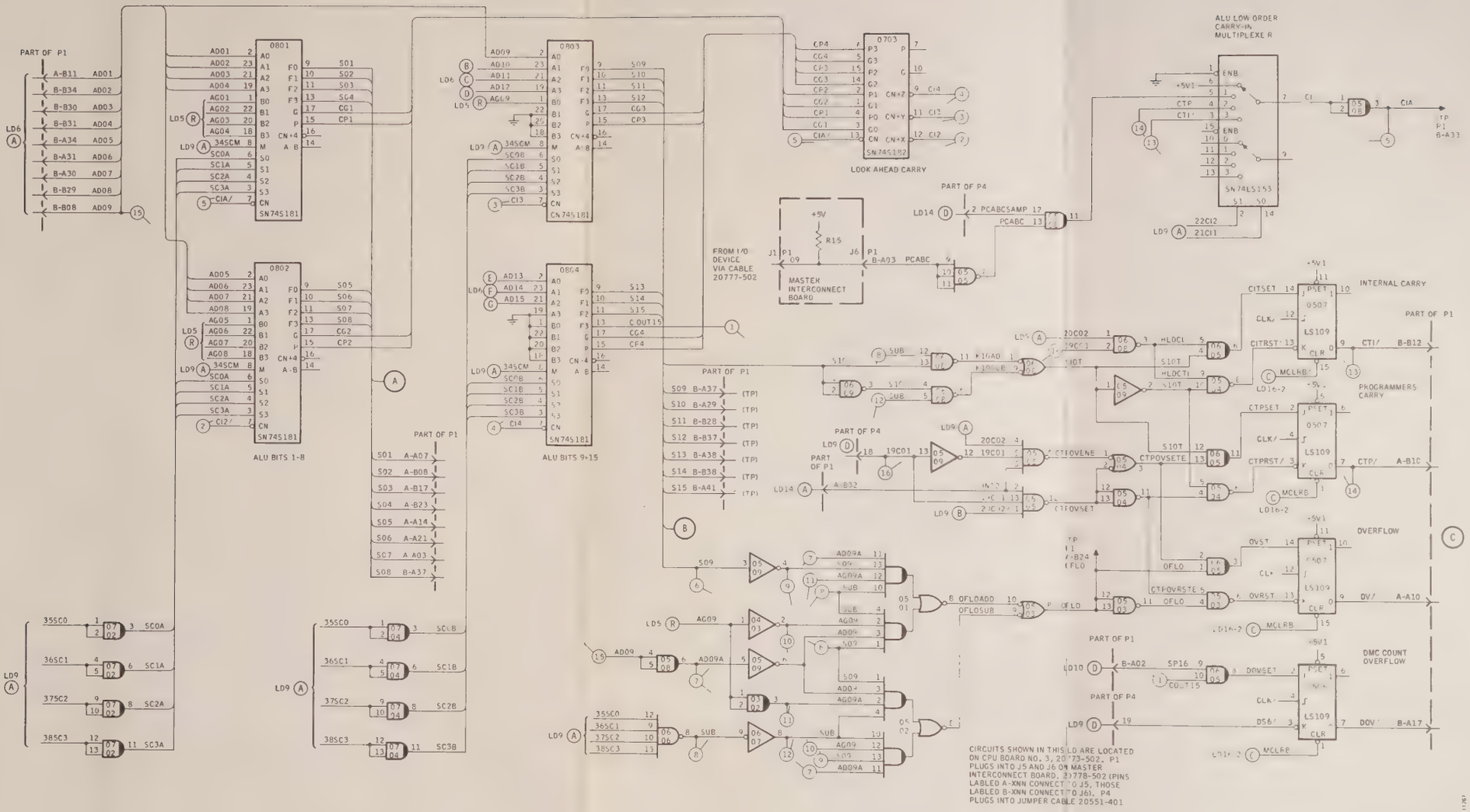
SIGNAL OUTPUT LIST FOR LD6

Output	Destination
AD01-AD09	LD7
AD10-AD15	LD7, LD8



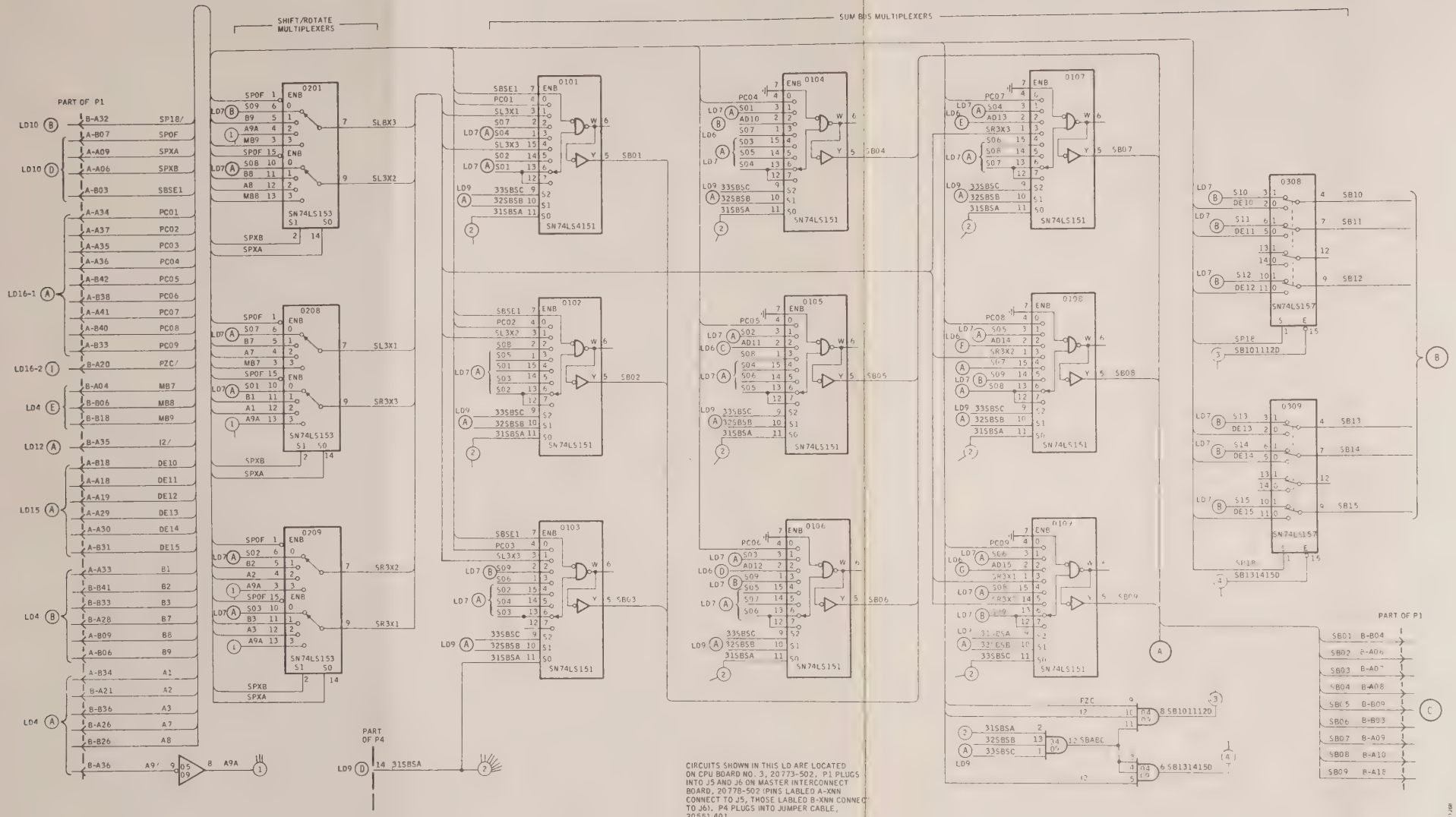
SIGNAL OUTPUT LIST FOR LD7

Output	Destination
CTI/	LD13
CTP	LD13, LD16-2
DOV/	LD16-2
OV/	LD13, LD16-2
S01-S15	LD8



SIGNAL OUTPUT LIST FOR LD8

Output	Destination
SB01, SB02	LD4, LD5, LD15, LD16-2
SB03	LD4, LD5, LD16-2
SB04	LD4, LD5, LD16-1, LD16-2
SB05-SB15	LD4, LD5, LD16-2

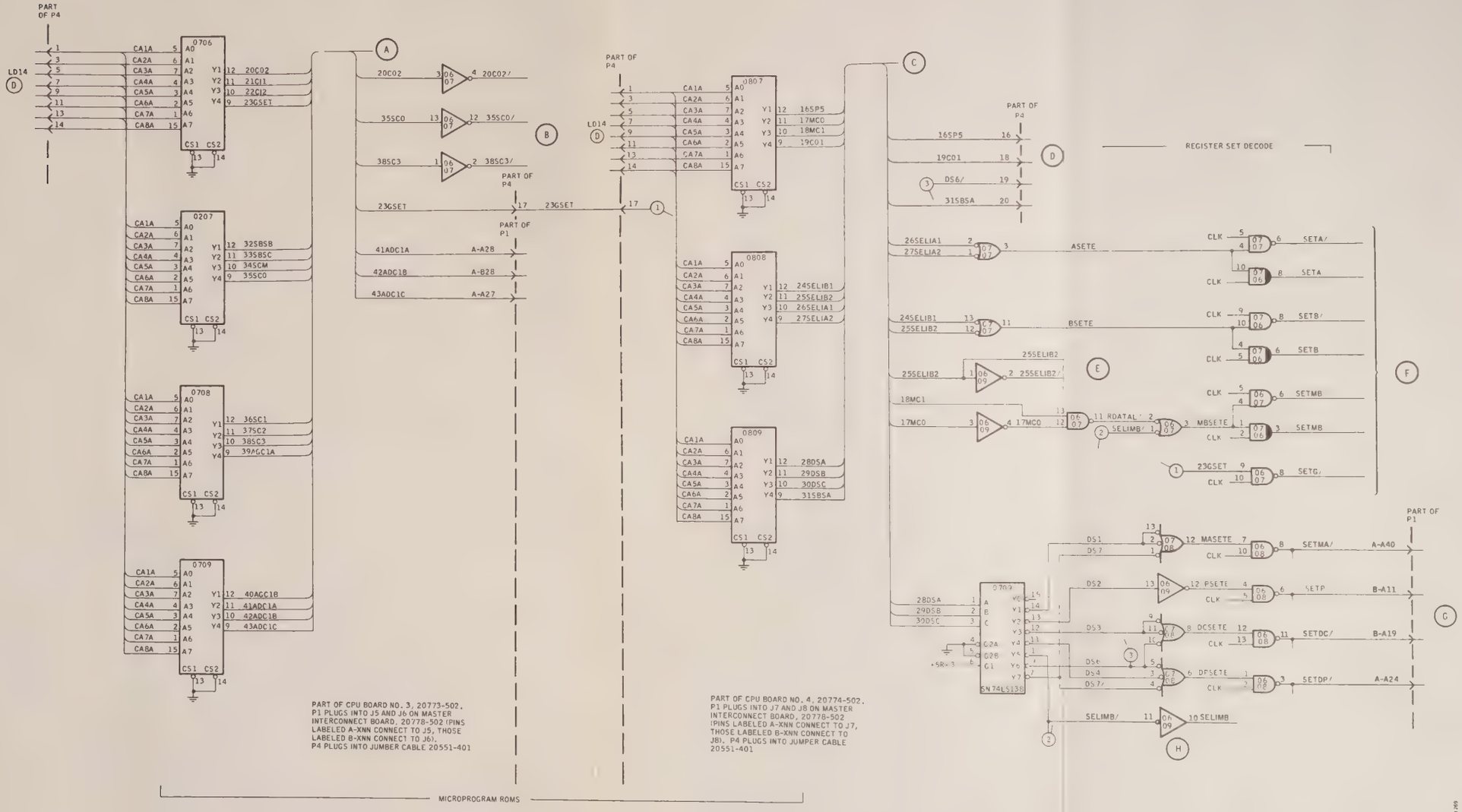


SIGNAL OUTPUT LIST FOR LD9

Output	Destination	Output	Destination	Output	Destination	Output	Destination	Output	Destination
DS6/	LD7	SETMA/	LD5	20C02/	LD7	31SBSA	LD8	38SC3	LD7
SELIMB	LD4	SETP/	LD5	21CI1	LD7	32SBSB	LD8	39AGC1A	LD5
SETA	LD4	16SP5	LD10	22C12	LD7	33SBSC	LD8	40AGC1B	LD5
SETB	LD4	17MC0	LD3	25SEL1B2	LD4	34SCM	LD7	41ADC1A	LD6
SETDC/	LD5	18MC1	LD3	25SEL1B2/	LD4	35SC0	LD7	42ADC1B	LD6
SETDP/	LD5	19CO1	LD7	26SEL1A1	LD4	36SC1	LD7	43ADC1C	LD6
SETG	LD4	20C02	LD7	27SEL1A2	LD4	37SC2	LD7		

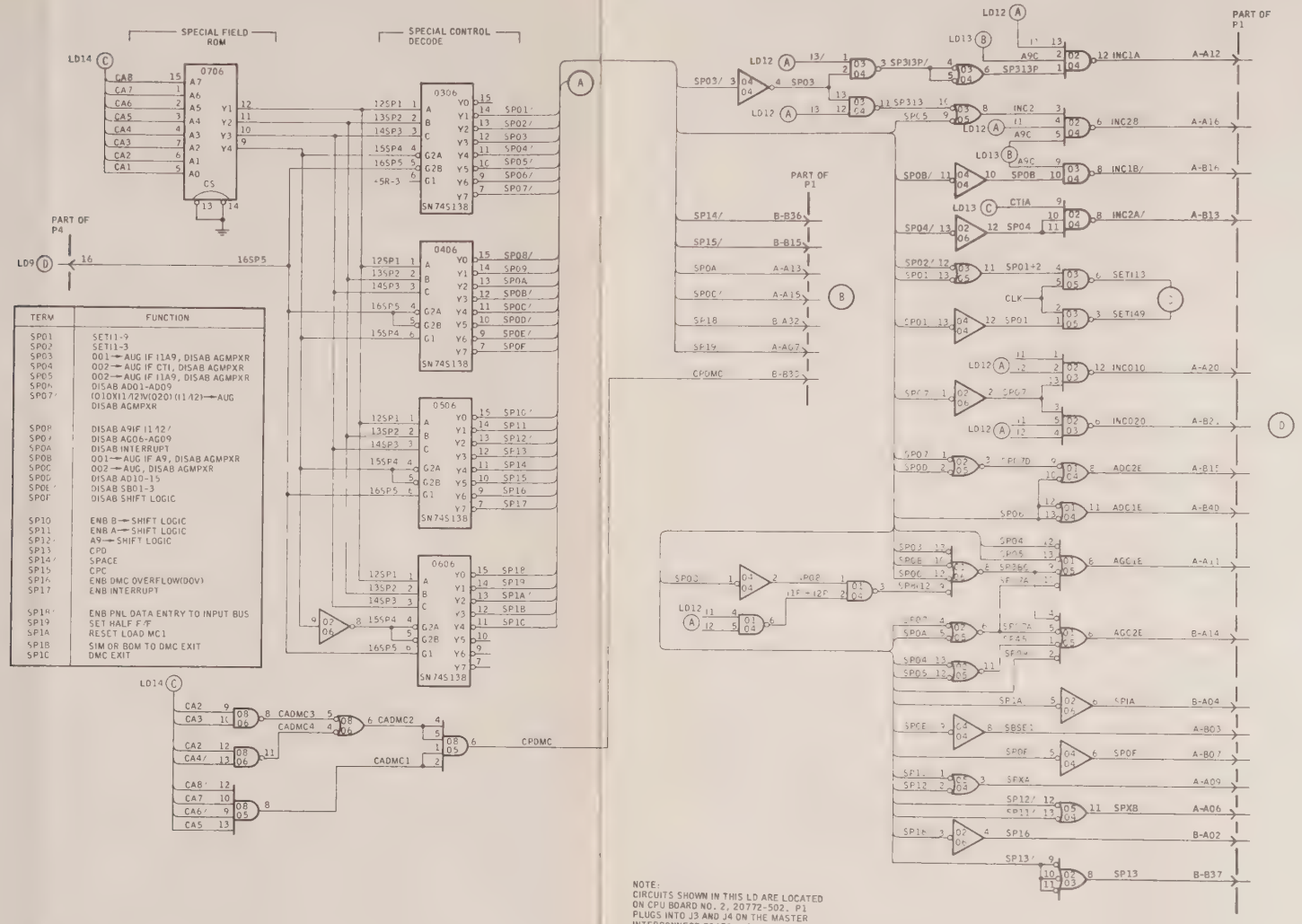
Microprogram Word Bit Locations on LDs

Bits	ID	LD
0-7	Next Field	11
8-11	Test	13
12-15	Special Branch	10
16-43	Micro	9



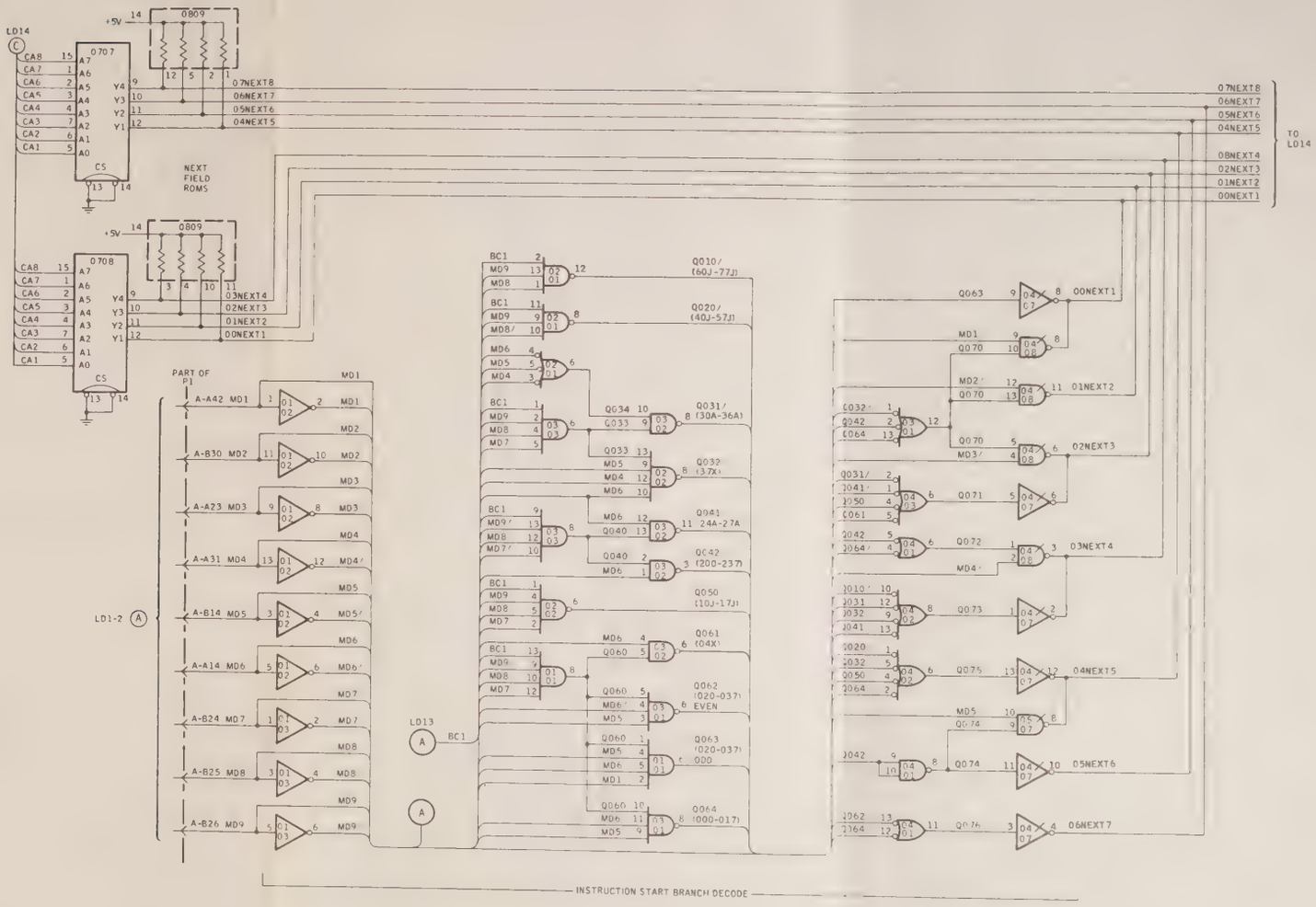
SIGNAL OUTPUT LIST FOR LD10

Output	Destination	Output	Destination	Output	Destination	Output	Destination
ADC1E	LD6	INC2B/	LD5	SPXB	LD8	SP17/	LD14
ADC2E	LD6	INC010/	LD5	SP0A/	LD5, LD14	SP18/	LD8, LD16-1
AGC1E	LD5	INC020/	LD5	SP0C/	LD5	SP19/	LD15
AGC2E	LD5	SBSE1	LD8	SP0F	LD8	SP1A	LD16-2
INC1A/	LD5	SET113/	LD12	SP13	LD16-2	SP1B/	LD14
INC1B/	LD5	SET149/	LD12	SP15/	LD16-2	SP1C/	LD14
INC2A/	LD5	SPXA	LD8	SP16	LD7		



SIGNAL OUTPUT LIST FOR LD11

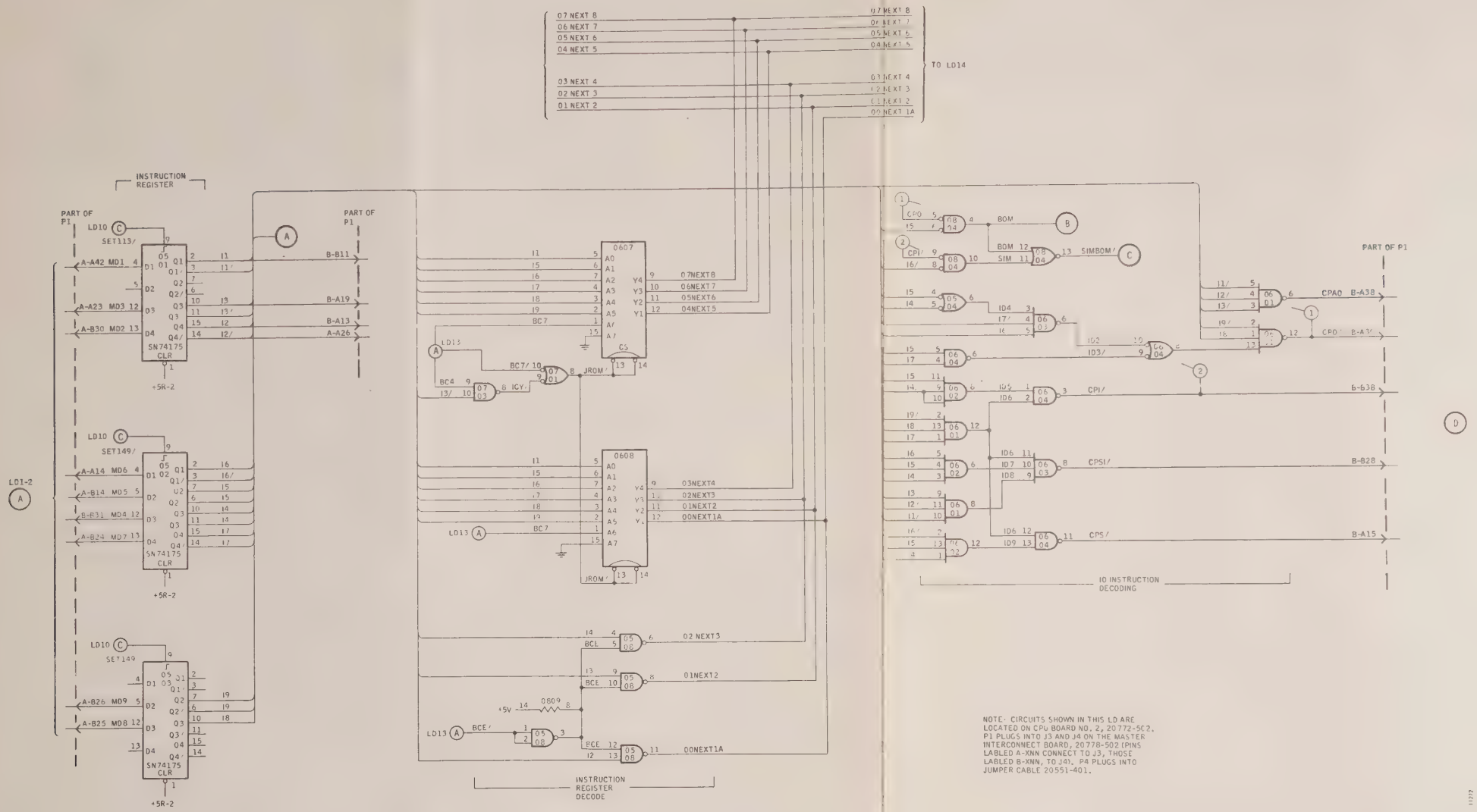
Output	Destination
MD1	LD13
MD1/	LD13
MD2	MD13
MD2/	MD13



NOTE: CIRCUITS SHOWN IN THIS LD ARE LOCATED ON CPU BOARD NO. 2, 20772-502. P1 PLUGS INTO J3 AND J4 ON THE MASTER INTERCONNECT BOARD, 20778-592 (PINS LABLED A-XNN, CONNECT TO J3, THOSE LABLED B-XNN, TO J4)

SIGNAL OUTPUT LIST FOR LD12

Output	Destination	Output	Destination	Output	Destination
BOM	LD14	I1/	LD10	I5/	LD13
CPAO	LD16-2	I2	LD10, LD16-2	I6	LD13
CPI/	LD16-1, LD16-2	I3	LD10, LD13, LD16-2	I6/	LD13
CPO/	LD16-2	I3/	LD10	I7	LD13
CPS/	LD16-1, LD16-2	I4	LD13	I7/	LD13
CPSI/	LD15, LD16-2	I4/	LD13		
I1	LD10, LD16-2	I5	LD13		



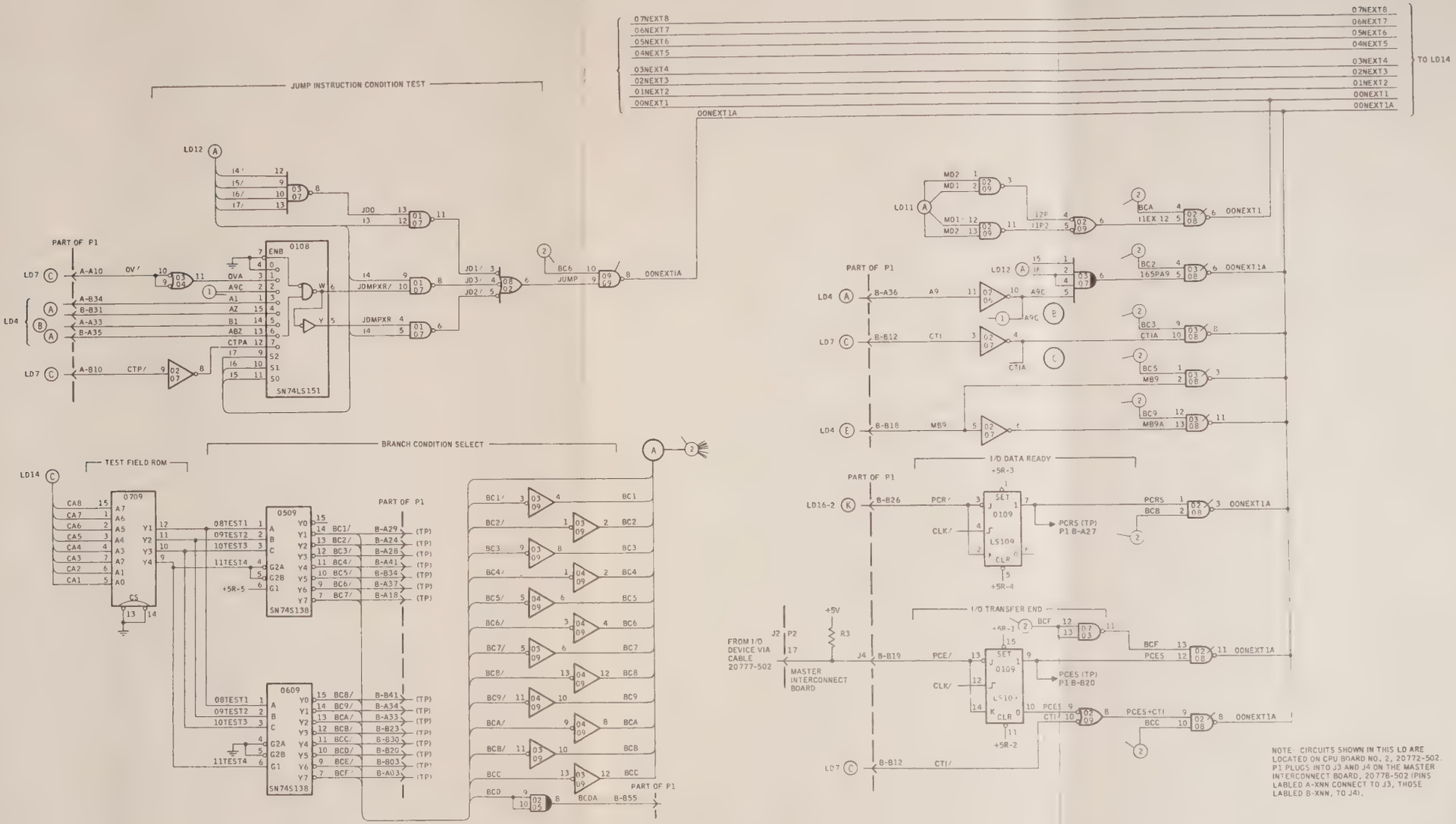
SIGNAL OUTPUT LIST FOR LD13

Output	Destination	Output	Destination
A9C	LD10	BCDA/	LD15, LD16-2, LD17
BC1	LD14	BCE	LD12
BC4	LD12	PC09/	LD13
BC5/	LD14		
BC7	LD12		
BC7/	LD12		
BCA	LD14		
MCD/	LD14		

BRANCH CONDITIONS

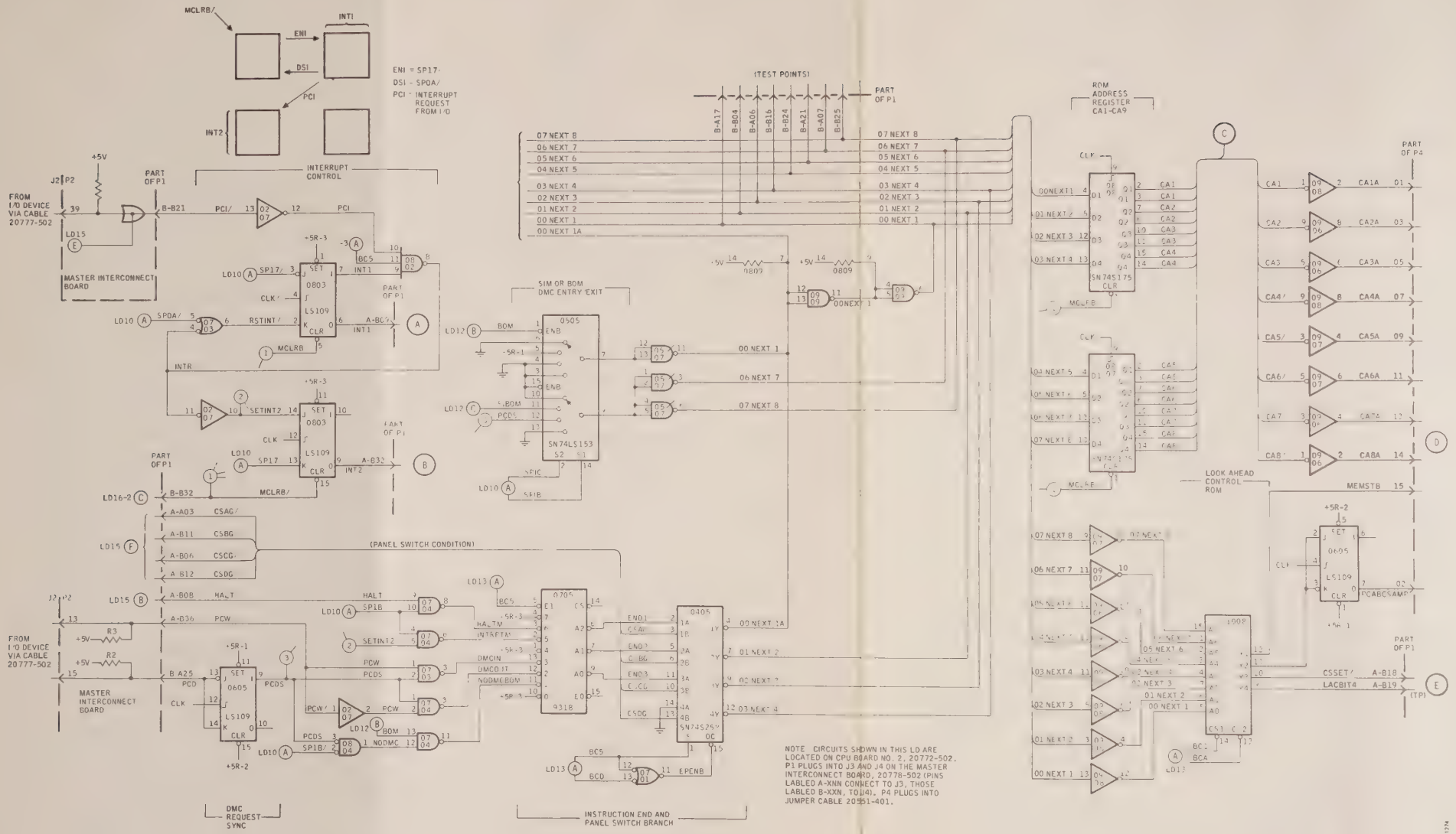
Number	Definition
BC00	None (no branch)
BC01	Start Instruction
BC02	A9 (AMAG/SMAG)
BC03	CTI
BC04	Indirect or EI
BC05	To F1 if not AALT, INTRPT, DMC
BC06	Jump Test
BC07	E2

Number	Definition
BC08	MB9
BC09	MB9/
BC0A	MD1 = MD2
BC0B	PCR
BC0C	CTI or PCES
BC0D	Panel Switches
BC0E	I4, I3, I2
BC0F	PCES



SIGNAL OUTPUT LIST FOR LD14

Output	Destination
CA1-CA8	LD10, LD11, LD13, LD17
CA1A-CA8A	LD9
CSSET/	LD16-2
INT1/	LD16-2
INT2/	LD7
MEMSTB/	LD3
PCABCSAMP	LD7

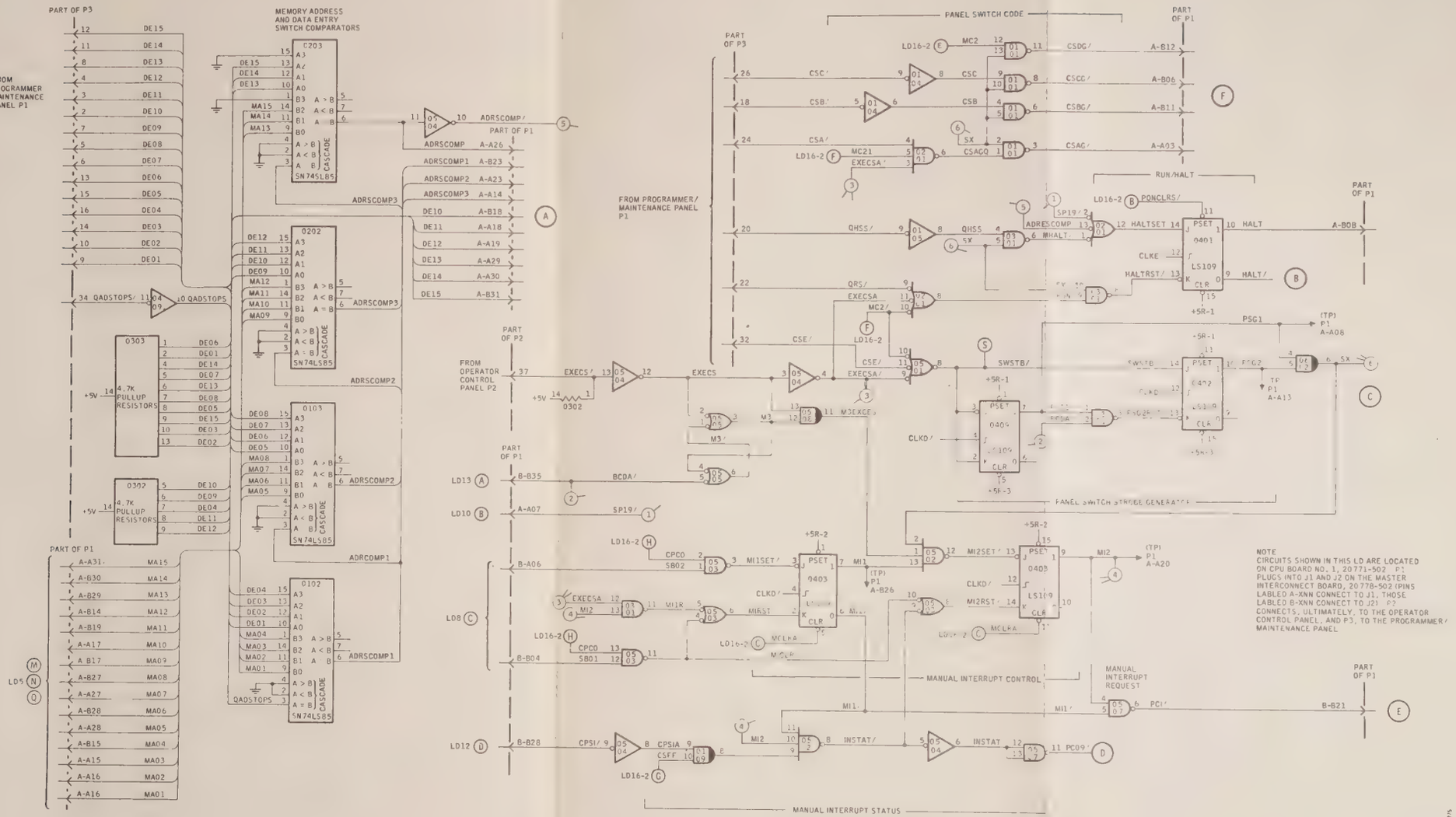


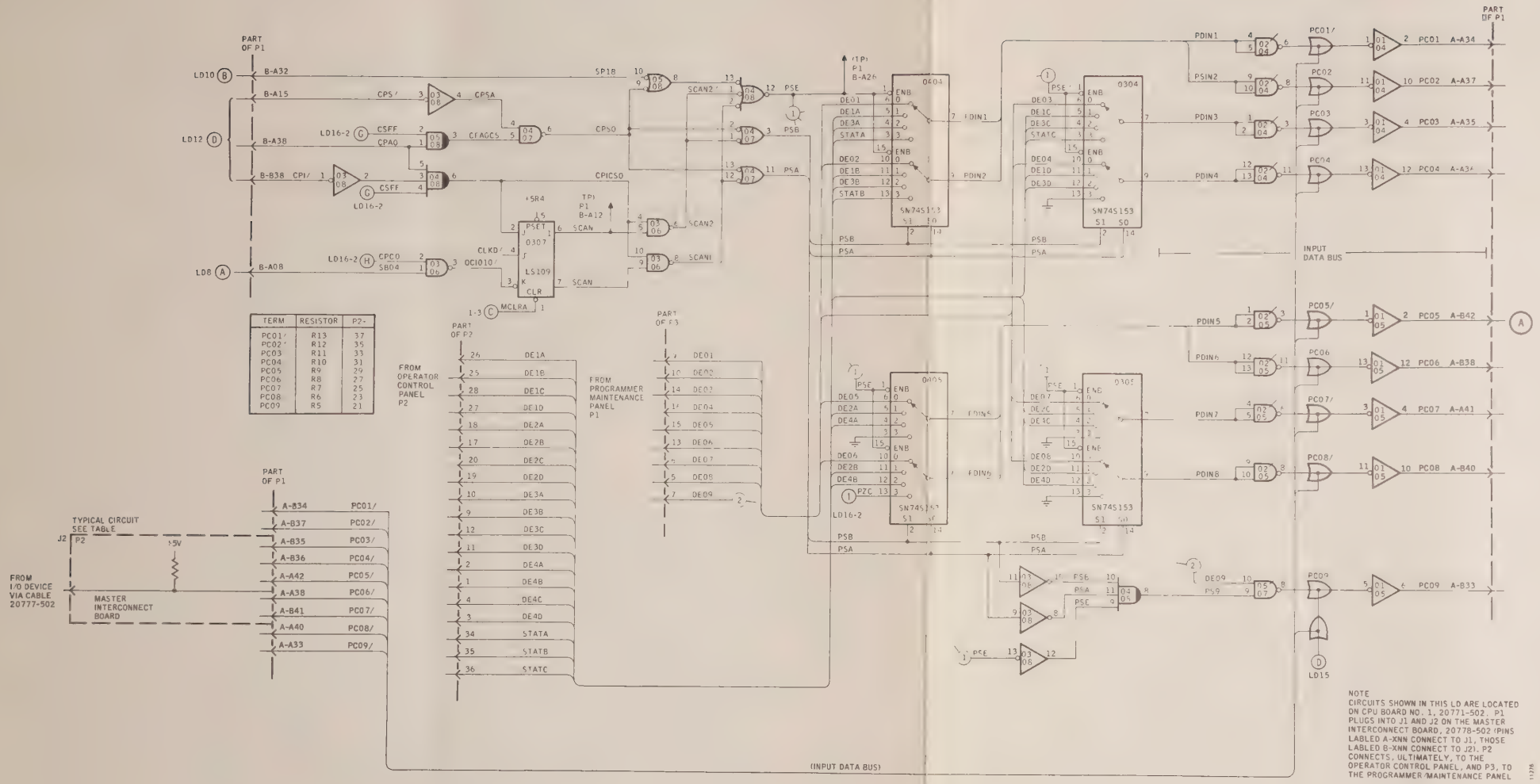
SIGNAL OUTPUT LIST FOR LD15

Output	Destination
CSAG/	LD14
CSBG/	LD14
CSCG/	LD14
CSDG/	LD14
DE10-DE15	LD8
HALT	LD14
HALT/	LD16-2
PCI/	LD14
SX	LD16-2

Terms Caused by Control Panel Switches

Term	Switch	Term	Switch
	P-1	EXECS	EXECUTE
	P+2	HALT	
	ENTER P	PSG2	POWER ON
CSE	A	PSG1/	
	B		
	M		
	HALT/STEP		
QHHS	HALT/STEP		
QRS	RUN		





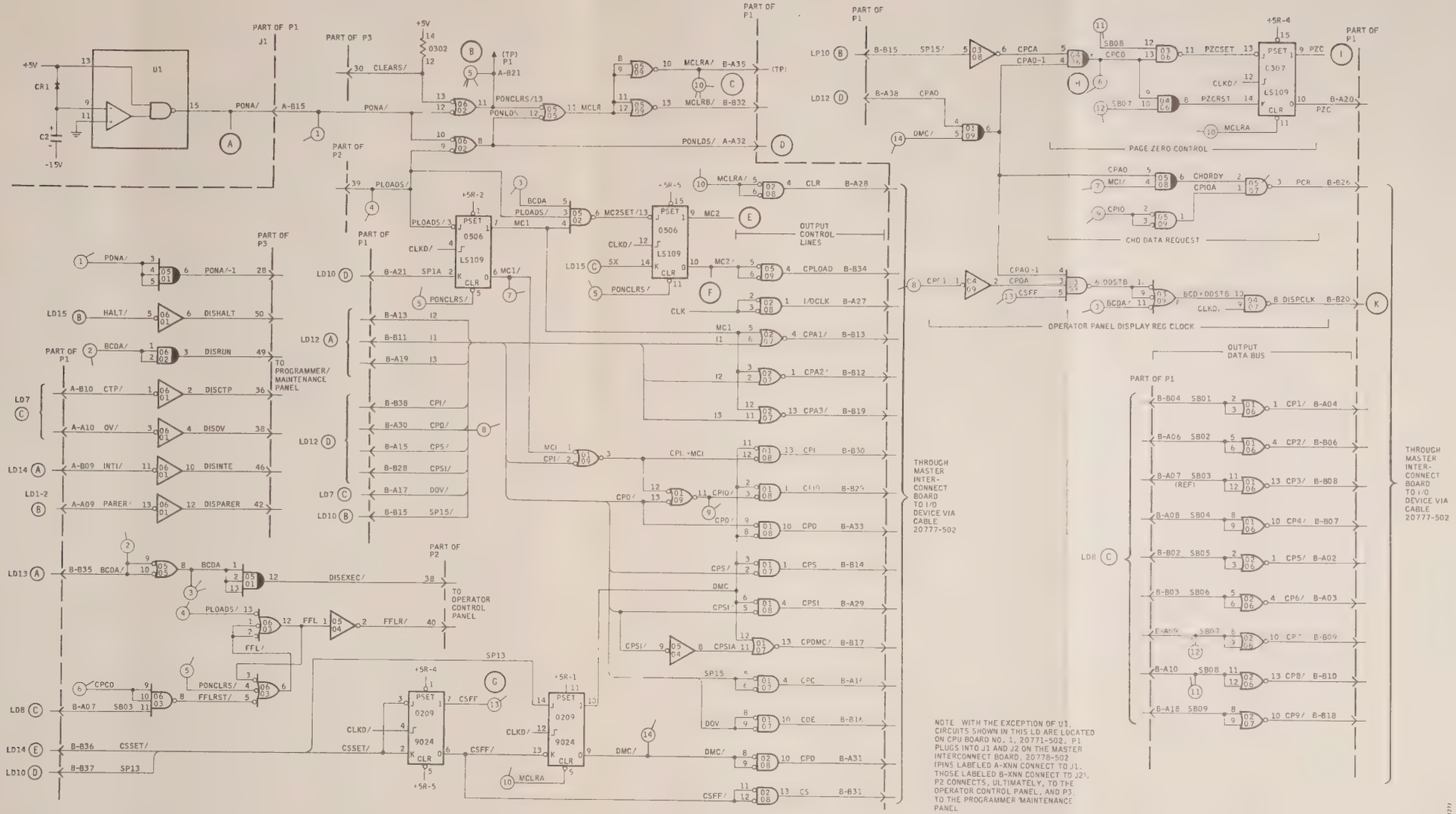
TERM	RESISTOR	P2-
PC01/	R13	37
PC02/	R12	35
PC03	R11	33
PC04	R10	31
PC05	R9	29
PC06	R8	27
PC07	R7	25
PC08	R6	23
PC09	R5	21

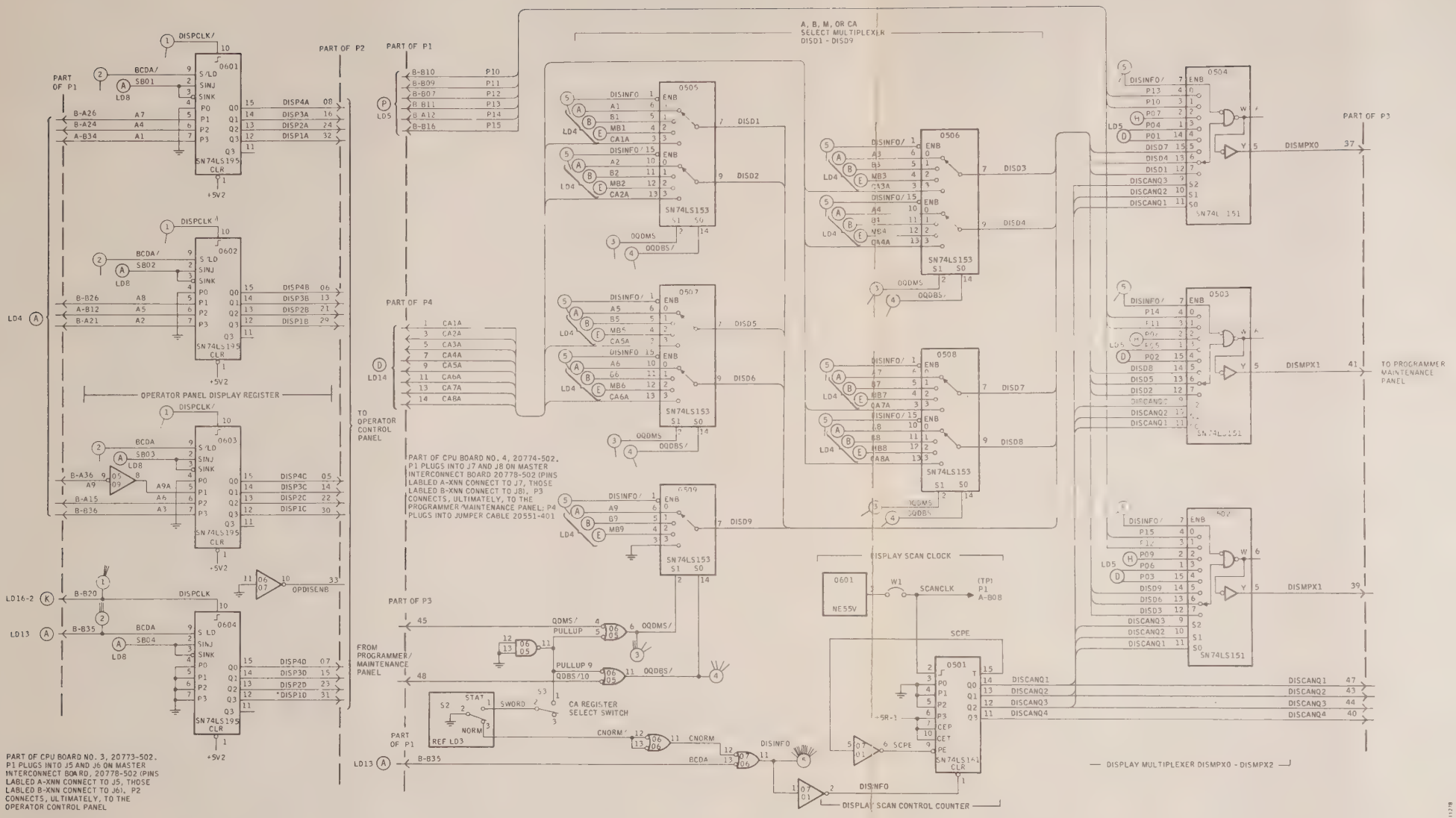
NOTE
CIRCUITS SHOWN IN THIS LD ARE LOCATED ON CPU BOARD NO. 1, 20771-502. P1 PLUGS INTO J1 AND J2 ON THE MASTER INTERCONNECT BOARD, 20778-502 (PINS LABLED A-XNN CONNECT TO J1, THOSE LABLED B-XNN CONNECT TO J2). P2 CONNECTS, ULTIMATELY, TO THE OPERATOR CONTROL PANEL, AND P3, TO THE PROGRAMMER/MAINTENANCE PANEL

LD16-1

SIGNAL OUTPUT LIST FOR LD16-2

Output	Destination	Output	Destination
CPCO	LD16-1	PCR/	LD13
CSFF	LD15	PONA/	LD1-1, LD1-2
DISPCLK/	LD17	PONLDS/	LD5
MCLRA/	LD15, LD16-1	PZC	LD16-1
MCLRB/	LD14	PZC/	LD8
MC2/	LD15		




PART OF P1
PART OF P2
PART OF P3
PART OF P4
DISPCLK/
BCDA/
SB01
SB02
SB03
SB04
LD8
B-A26
B-A24
A-B34
B-B26
B-A12
A-B21
B-A36
B-A15
B-B36
B-B20
B-B35
A7
A4
A1
A8
A5
A2
A9
A6
A3
SN74LS195
CLR
+5V2
DISP4A
DISP3A
DISP2A
DISP1A
DISP4B
DISP3B
DISP2B
DISP1B
DISP4C
DISP3C
DISP2C
DISP1C
DISP4D
DISP3D
DISP2D
DISP1D
OPERATOR PANEL DISPLAY REGISTER
OPDISENB
TO OPERATOR CONTROL PANEL
B-B10
B-B09
B-B07
B-B11
B-A12
B-B16
CA1A
CA2A
CA3A
CA4A
CA5A
CA6A
CA7A
CA8A
A, B, M, OR CA SELECT MULTIPLEXER DISD1 - DISD9
SN74LS153
DISD1
DISD2
DISD3
DISD4
DISD5
DISD6
DISD7
DISD8
DISD9
QQDMS
QQDBS/
PART OF CPU BOARD NO. 4, 20774-502. P1 PLUGS INTO J7 AND J8 ON MASTER INTERCONNECT BOARD 20778-502 (PINS LABLED A-XNN CONNECT TO J7, THOSE LABLED B-XNN CONNECT TO J8). P3 CONNECTS, ULTIMATELY, TO THE PROGRAMMER MAINTENANCE PANEL; P4 PLUGS INTO JUMPER CABLE 20551-401
FROM PROGRAMMER/ MAINTENANCE PANEL
QDMS/
PULLUP
QQDBS/10
PULLUP 9
STAT
SWORD
NORM
REF LD3
CA REGISTER SELECT SWITCH
CNORM
DISINFO
DISPLAY SCAN CLOCK
NE55V
SCANCLK
(TP) P1 A-B08
SCPE
DISPLAY SCAN CONTROL COUNTER
DISCANQ1
DISCANQ2
DISCANQ3
DISCANQ4
DISMPX0
DISMPX1
DISPLAY MULTIPLEXER DISMPX0 - DISMPX2
TO PROGRAMMER MAINTENANCE PANEL
SN74LS151
PART OF CPU BOARD NO. 3, 20773-502. P1 PLUGS INTO J5 AND J6 ON MASTER INTERCONNECT BOARD, 20778-502 (PINS LABLED A-XNN CONNECT TO J5, THOSE LABLED B-XNN CONNECT TO J6). P2 CONNECTS, ULTIMATELY, TO THE OPERATOR CONTROL PANEL

SECTION 5

DIAGNOSTIC OPERATION AND HALT DEFINITIONS

```
$$ A,T    CREATE SYSTEM TAPE FOR CALCOMP 910/915 CONTROLLER                    00000010
```



```
*                    921 CPU DIAGNOSTICS
*                                                                             00000010
*                    921 CPU DIAGNOSTICS                                      00000020
*                                                                             00000030
*                       DATE APR 1977                                         00000040
*                                                                             00000050
*        IC # 433220-1      PART # 10275-902-000      7-TRK NRZI              00000060
*        IC # 433230-0      PART # 10276-902-000      9-TRK NRZI              00000070
*        IC # 433240-9      PART # 10277-902-000      9-TRK PE                00000080
*                                                                             00000090
*                                                                             00000100
*        CALCOMP MODEL 921 CONTROLLER DIAGNOSTIC TEST PROGRAMS                00000110
*                                                                             00000120
*************************************************************************00000130
*                  *MODEL 921 DIAGNOSTIC TESTS*                             00000140
*************************************************************************00000150
*                                                                             00000160
*                                                                             00000170
*                                                                             00000180
*                              ************                                   00000190
*                              *TEST TABLE*                                   00000200
*                              ************                                   00000210
*                                                                             00000220
*                                                                             00000230
*************************************************************************00000240
* TEST NUMBER    STATUS SWITCH    LOCATION          TITLE                    00000250
*                  POSITION                                                   00000260
*     0              0              7000      STATUS SWITCH TEST             00000270
*                                                                             00000280
*     1              1              0002      INSTRUCTION TEST               00000290
*                                                                             00000300
*     2              2              7034      DECODER DRIVER TEST            00000310
*                                                                             00000320
*     3              3              7052      DATA ENTRY SWITCHES TEST       00000330
*                                                                             00000340
*     4              4              7120      ADDER AND SUM-BUS TEST         00000350
*                                                                             00000360
*     5              5              7172      CARRY LOOK-AHEAD TEST          00000370
*                                                                             00000380
*     6              6              5154      MANUAL INTERRUPT TEST          00000390
*                                                                             00000400
*     7              7              4000      I/O SIMULATOR TEST             00000410
*                                                                             00000420
*************************************************************************00000430
        EJT                                                                  00000440
```

```
*                                                                              00000450
********************************************************************************00000460
*                    MODEL 921 CONTROLLER TESTS                                00000470
********************************************************************************00000480
*                                                                              00000490
*        ASSUMTIONS*  IT IS ASSUMED THAT MEMORY, POWER SUPPLIES, AND THE       00000500
*        CONTROL PANEL HAVE BEEN PREVIOUSLY TESTED AT SEPERATE TEST            00000510
*        STATIONS.                                                             00000520
*                                                                              00000530
*                    OPERATING PROCEDURES                                      00000540
*                                                                              00000550
*        ON SYSTEM LOADER BOARD SET SWITCH 5 = 1.                              00000560
*        SET S. SWITCH TO 0 (DIAGNOSTIC TAPE LOADER).                          00000570
*        LOAD DIAGNOSTIC MAG TAPE.                                             00000580
*        PUSH 'LOAD' BUTTON. THE CPU DIAGNOSTIC SHOULD NOW BE LOADED           00000590
*        INTO MEMORY.                                                          00000600
*                                                                              00000610
*        SET STATUS SWITCH (S.S) TO 0. PUSH 'EXEC' BUTTON.                     00000620
*        WE SHOULD NOW BE EXECUTING TEST0.                                     00000630
*        FOLLOW THE DIRECTIONS TO EXECUTE TEST0 THRU TEST7 AS OUTLINED         00000640
*        BELOW.                                                                00000650
*                                                                              00000660
********************************************************************************00000670
        EJT                                                                   00000680
```

```
*****************************************************************************00000690
*                    ERROR HALT PROCESSING                                    00000700
*****************************************************************************00000710
*                                                                             00000720
*         WHEN AN ERROR OCCURS DURING EXECUTION OF ONE OF THE CPU TESTS       00000730
*         THE PROGRAM EXITS TO THE HALT MODE. THE MEMORY ADDRESS WHERE        00000740
*         THE ERROR OCCURED WILL BE DISPLAYED ON THE NUMERIC READOUT          00000750
*         INDICATOR (NRI) DISPLAY LIGHTS. THE TWO MOST SIGNIFICANT            00000760
*         DIGITS OF THE ADDRESS WILL BE DISPLAYED FIRST. THEN WHEN            00000770
*         'EXECUTE' IS PRESSED THE THREE LEAST SIGNIFICANT DIGITS OF THE      00000780
*         ADDRESS WILL BE DISPLAYED. SUBSEQUENT PRESSING OF 'EXECUTE'         00000790
*         WILL CAUSE THE CONTENTS OF THE A-REGISTER AND THEN THE B-REG-       00000800
*         ISTER TO BE DISPLAYED ON THE NRI. AFTER THE ADDRESS AND THE         00000810
*         REGISTERS HAVE BEEN DISPLAYED, PRESSING 'EXECUTE' WILL CAUSE        00000820
*         THE PROGRAM TO RESUME CPU TESTING.                                  00000830
*                                                                             00000840
*****************************************************************************00000850
         EJT                                                                  00000860
```

921 CPU DIAGNOSTICS

```
**********************************************************************00000870
* TEST0              STATUS SWITCH TEST                                00000880
*                                                                      00000890
*        TURN S. SWITCH TO POSITION 0 AND WATCH 0000 DISPLAYED ON THE  00000900
*        CONTROL PANEL. TURN S. SWITCH TO POSITION 1 AND WATCH 1111    00000910
*        DISPLAYED  REPEAT THIS PROCEDURE BY TURNING S. SWITCH POSITION00000920
*        TO 2 THRU 7. SET S. SWITCH TO DESIRED TEST NUMBER AND SET DATA00000930
*        ENTRY SWITCH TO 0001 TO EXIT FROM THIS TEST.                  00000940
**********************************************************************00000950
* TEST1              INSTRUCTION TEST                                  00000960
*                                                                      00000970
*        SET S. SWITCH TO POSITION 1. FOR A SUCCESSFUL COMPLETION OF THE00000980
*        I-TEST , THE TEST SHOULD LOOP AROUND ITSELF AND SUCCESSIVELY  00000990
*        ADVANCE THE DISPLAY PANEL COUNT BY ONE. CHANGE S. SWITCH TO   00001000
*        NEW POSITION TO EXIT FROM THIS TEST.                          00001010
**********************************************************************00001020
* TEST2              LED 7-SEGMENT NUMERICAL DISPLAY INDICATOR TEST    00001030
*                                                                      00001040
*        SET S. SWITCH TO POSITION 2.  THIS TEST IF SUCCESSFULLY       00001050
*        EXECUTED, SHOULD DISPLAY 0000,1111,-----,9999,AND THE 6 ILLEGAL00001060
*        CODES AND THEN DISPLAY 0000,1111,9999,------AGAINAND SO ON.   00001070
*        CHANGE S. SWITCH POSITION TO GET OUT OF THIS TEST.            00001080
**********************************************************************00001090
* TEST3              DATA ENTRY SWITCHES AND DISPLAY LOGIC TEST        00001100
*                                                                      00001110
*        SET S. SWITCH TO POSITION 3 THE CONTROL PANEL SHOULD COPY THE 00001120
*        DATA ENTRY SWITCH POSITIONS. CHANGE S. SWITCH POSITION TO EXIT00001130
**********************************************************************00001140
* TEST4              ADDER,SUM-BUS, ADDENED AND AUGENED BUS,A,B,G,AND MB00001150
*                    REGISTER TEST                                     00001160
*                                                                      00001170
*        SET S. SWITCH TO POSITION 4. THIS TEST WILL INCREMENT A       00001180
*        NUMBER BY ONE SUCCESSIVELY AND DISPLAY EACH INCREMENTED NUMBER00001190
**       ON THE PANEL.  WHEN THE PANEL DISPLAYS 7777, THE NEXT NUMBER  00001200
*        IS 0000.                                                      00001210
**********************************************************************00001220
* TEST5              CARRY LOOK-AHEAD LOGIC TEST                       00001230
*                                                                      00001240
*        SET S. SWITCH TO POSITION 5. IF SUCCESSFULLY EXECUTED         00001250
*        THE TEST WILL CONTINUOUSLY LOOP-AROUND.  IN CASE OF FAILURE,  00001260
*        THE TEST WILL  STOP  AT FAIL1, FAIL2,--FAIL9.                 00001270
*        CHANGE S. SWITCH POSITION TO EXIT FROM THIS TEST.             00001280
**********************************************************************00001290
* TEST6              MANUAL INTERRUPT TEST                             00001300
*                                                                      00001310
*        SET S. SWITCH TO POSITION 6. PRESS EXECUTE BUTTON. THE P-CNTR 00001320
*        SHOULD DISPLAY 5162.                                          00001330
*        PRESS EXECUTE BUTTON. THE PROGRAM NOW IS WAITING FOR A        00001340
*        MANUAL INTERRUPT. PRESS EXECUTE BUTTON. THE P-COUNTER SHOULD  00001350
*        AGAIN DISPLAY 5162. REPEAT AS MANY TIMES AS NECESSARY.        00001360
*        CHANGE  S. SWITCH TO GET OUT OF THIS TEST.                    00001370
**********************************************************************00001380
         EJT                                                          00001390
```

```
**************************************************************************00001400
* TEST7              I/O SIMULATOR TEST                                   00001410
*                                                                         00001420
*       SET S. SWITCH TO POS 7.  WHEN THE PROGRAM HALTS, PLACE            00001430
*       THE SIMULATOR ON-OFF SWITCH TO THE ON POSITION. ENTER THE         00001440
*       DEVICE ADDRESS NUMBER ON THE S. SWITCH, HIT 'CLEAR' AND           00001450
*       PRESS 'EXEC'. IF THE TEST HAS RUN SUCESSFULLY IT WILL HALT        00001460
*       AT LOCATION 4425 AND '777' WILL BE DISPLAYED IN THE               00001470
*       A-REG. CHANGE S. SWITCH AND HIT 'EXEC' TO EXIT FROM               00001480
*       FROM THIS TEST.                                                   00001490
**************************************************************************00001500
       EJT                                                                00001510
```

```
*****************************************************************************00001520
*                    DIAGNOSTIC PROGRAM HALTS                                00001530
*****************************************************************************00001540
*                                                                             00001550
*                                                                             00001560
*****************************************************************************00001570
* HALT LOCATION SHOWN ON                  MEANING                             00001580
* NRI DISPLAY LIGHTS                                                          00001590
*     (OCTAL)                                                                 00001600
*                                                                             00001610
*        00006          JUMP(INDIRECT) INSTRUCTION FAILS TO JUMP.             00001620
*                                                                             00001630
*        00034          ILLEGAL INTERRUPT CONDITION.                          00001640
*                                                                             00001650
*        00040          JUMP INSTRUCTION FAILED.                              00001660
*                                                                             00001670
*        00046          LIA INSTRUCTION FAILED IF A=0 OR JNZ INSTRUCTION      00001680
*                       FAILED IF A=1.                                        00001690
*        00057          JNZ INSTRUCTION FAILED IF A=1 AND B=1; OR             00001700
*                       CBA INSTRUCTION FAILED IF A NOT EQUAL 1, AND B=1      00001710
*                       OR LIB INSTRUCTION FAILED.                            00001720
*                                                                             00001730
*        00072          EIA INSTRUCTION FAILED IF A=777 AND B=777;            00001740
*                       OR LIB INSTRUCTION FAILED IF B NOT EQUAL 777; OR      00001750
*                       CBA OR EIA INSTRUCTION FAILED IF A NOT EQUAL          00001760
*                       777 OR 0009                                           00001770
*                                                                             00001780
*        00107          ZED INSTRUCTION FAILED TO SET A=0                     00001790
*        00111          ZED INSTRUCTION FAILED TO SET B=09                    00001800
*        00126          EIA INSTRUCTION FAILED.                               00001810
*        00146          EIB INSTRUCTION FAILED.                               00001820
*                                                                             00001830
*        00156          JZE INSTRUCTION FAILED.                               00001840
*                                                                             00001850
*        00166          JZED INSTRUCTION FAILED.                              00001860
*                                                                             00001870
*        00216          SRB1 INSTRUCTION FAILED.                              00001880
*                                                                             00001890
*        00227          SRA1 INSTRUCTION FAILED.                              00001900
*        00240          SLA1 INSTRUCTION FAILED.                              00001910
*                                                                             00001920
*        00255          SLB1 INSTRUCTION FAILED                               00001930
*                                                                             00001940
*        00267          SRB3 INSTRUCTION FAILED.                              00001950
*                                                                             00001960
*        00300          SRA3 INSTRUCTION FAILED.                              00001970
*                                                                             00001980
*        00311          SLA3 INSTRUCTION FAILED.                              00001990
*                                                                             00002000
*        00323          SLB3 INSTRUCTION FAILED.                              00002010
*                                                                             00002020
*        00335          RRB1 INSTRUCTION FAILED.                              00002030
*                                                                             00002040
*        00346          RRA1 INSTRUCTION FAILED.                              00002050
*                                                                             00002060
```

```
*        00357        RLA1 INSTRUCTION FAILED.                                  00002070
*                                                                              00002080
*        00371        RLB1 INSTRUCTION FAILED.                                  00002090
*                                                                              00002100
*        00403        RRB3 INSTRUCTION FAILED.                                  00002110
*                                                                              00002120
*        00414        RRA3 INSTRUCTION FAILED.                                  00002130
*                                                                              00002140
*        00425        RLA3 INSTRUCTION FAILED.                                  00002150
*                                                                              00002160
*        00437        RLB3 INSTRUCTION FAILED.                                  00002170
*                                                                              00002180
*        00454        SRD1 INSTRUCTION FAILED.                                  00002190
*                                                                              00002200
*        00471        ARS1 INSTRUCTION FAILED.                                  00002210
*                                                                              00002220
*        00506        SLD1 INSTRUCTION FAILED.                                  00002230
*                                                                              00002240
*        00540        SRD3 INSTRUCTION FAILED.                                  00002250
*                                                                              00002260
*        00555        ARS3 INSTRUCTION FAILED.                                  00002270
*                                                                              00002280
*        00572        SLD3 INSTRUCTION FAILED                                   00002290
*                                                                              00002300
*        00624        RRD1 INSTRUCTION FAILED.                                  00002310
*                                                                              00002320
*        00673        RRD3 INSTRUCTION FAILED.                                  00002330
*                                                                              00002340
*        00725        RLD3 INSTRUCTION FAILED.                                  00002350
*                                                                              00002360
*        00742        LDMC OR CDMC INSTRUCTION FAILED.                          00002370
*                                                                              00002380
*        00751        CDMC INSTRUCTION FAILED.                                  00002390
*                                                                              00002400
*        02013        MIB INSTRUCTION FAILED.                                   00002410
*                                                                              00002420
*        02040        MIA INSTRUCTION FAILED.                                   00002430
*                                                                              00002440
*        02051        CAB INSTRUCTION FAILED.                                   00002450
*                                                                              00002460
*        02062        PCKA INSTRUCTION FAILED WITH BITS 1-5 SET.                00002470
*                                                                              00002480
*        02073        PCKA INSTRUCTION FAILED WITH BITS 4-9 SET.                00002490
*                                                                              00002500
*        02104        COMA INSTRUCTION FAILED.                                  00002510
*                                                                              00002520
*        02120        EAB INSTRUCTION FAILED.                                   00002530
*                                                                              00002540
*        02135        XAB INSTRUCTION FAILED.                                   00002550
*                                                                              00002560
*        02152        COMD INSTRUCTION FAILED.                                  00002570
*                                                                              00002580
*        02164        COMB INSTRUCTION FAILED.                                  00002590
*                                                                              00002600
*                                                                              00002610
```

```
*        02177        LIAX INSTRUCTION FAILED.                          00002620
*                                                                       00002630
*        02214        LIBX INSTRUCTION FAILED.                          00002640
*                                                                       00002650
*        02225        AIA INSTRUCTION FAILED.                           00002660
*                                                                       00002670
*        02240        AIAX INSTRUCTION FAILED.                          00002680
*                                                                       00002690
*        02251        AIB INSTRUCTION FAILED.                           00002700
*                                                                       00002710
*        02266        AIBX INSTRUCTION FAILED.                          00002720
*                                                                       00002730
*        02302        EAI INSTRUCTION FAILED.                           00002740
*                                                                       00002750
*        02317        EAIX INSTRUCTION FAILED.                          00002760
*                                                                       00002770
*        02333        EBI INSTRUCTION FAILED.                           00002780
*                                                                       00002790
*        02351        EBIX INSTRUCTION FAILED.                          00002800
*                                                                       00002810
*        02362        EIAX INSTRUCTION FAILED.                          00002820
*                                                                       00002830
*        02375        EIBX INSTRUCTION FAILED.                          00002840
*                                                                       00002850
*        02406        DJ INSTRUCTION FAILED.                            00002860
*                                                                       00002870
*        02427        DJ INSTRUCTION FAILED TO AUTO INDEX               00002880
*                                                                       00002890
*        02437        JOV INSTRUCTION FAILED IF A=377 AND OV            00002900
*                     ARE SET; OTHERWISE AIA INSTRUCTION FAILED.        00002910
*                                                                       00002920
*        02451        JOV INSTRUCTION FAILED.                           00002930
*                                                                       00002940
*        02461        JOV INSTRUCTION FAILED.                           00002950
*                                                                       00002960
*        02471        JNOV INSTRUCTION FAILED WITH OV NOT SET.          00002970
*                                                                       00002980
*        02503        JNOV INSTRUCTION FAILED WITH OV SET.              00002990
*                                                                       00003000
*        02511        JMI INSTRUCTION FAILED ON MINUS                   00003010
*                                                                       00003020
*        02521        JMI INSTRUCTION FAILED ON PLUS.                   00003030
*                                                                       00003040
*        02531        JPL INSTRUCTION FAILED ON MINUS.                  00003050
*                                                                       00003060
*        02537        JPL INSTRUCTION FAILED ON PLUS                    00003070
*                                                                       00003080
*        02545        JOD INSTRUCTION FAILED ON ODD.                    00003090
*                                                                       00003100
*        02561        JEV INSTRUCTION FAILED ON EVEN.                   00003110
*                                                                       00003120
*        02571        JEV INSTRUCTION FAILED ON ODD.                    00003130
*                                                                       00003140
*        02577        JODD INSTRUCTION FAILED ON ODD.                   00003150
*                                                                       00003160
```

```
*  02606   JODD INSTRUCTION FAILED ON EVEN.                00003170
*                                                          00003180
*  02613   JEVD INSTRUCTION FAILED ON EVEN.                00003190
*                                                          00003200
*  02623   JEVD INSTRUCTION FAILED ON ODD.                 00003210
*                                                          00003220
*  02632   JNZD INSTRUCTION FAILED ON ZERO.                00003230
*                                                          00003240
*  02640   JNZD INSTRUTION FAILED ON NON-ZERO.             00003250
*                                                          00003260
*  02650   JCT INSTRUCTION FAILED ON CT SET.               00003270
*                                                          00003280
*  02660   JCT INSTRUCTION FAILED ON CT NOT SET.           00003290
*                                                          00003300
*  02672   JNCT INSTRUCTION FAILED ON CT SET.              00003310
*                                                          00003320
*  02700   JNCT INSTRUCTION FAILED ON CT NOT SET.          00003330
*                                                          00003340
*  02711   LB INSTRUCTION FAILED.                          00003350
*                                                          00003360
*  02723   DRS INSTRUCTION FAILED.                         00003370
*                                                          00003380
*  02745   RLMI INSTRUCTION FAILED.                        00003390
*                                                          00003400
*  03020   LA INSTRUCTION FAILED.                          00003410
*                                                          00003420
*  03031   SUBA INSTRUCTION FAILED.                        00003430
*                                                          00003440
*  03046   IRS INSTRUCTION FAILED.                         00003450
*                                                          00003460
*  03055   IRS INSTRUCTION FAILED.                         00003470
*                                                          00003480
*  03071   STZ OR STA INSTRUCTION FAILED.                  00003490
*                                                          00003500
*  03103   ADB INSTRUCTION FAILED.                         00003510
*                                                          00003520
*  03114   SUB INSTRUCTION FAILED.                         00003530
*                                                          00003540
*  03131   STB INSTRUCTION FAILED.                         00003550
*                                                          00003560
*  03147   XMB INSTRUCTION FAILED.                         00003570
*                                                          00003580
*  03166   XMB INSTRUCTION FAILED.                         00003590
*                                                          00003600
*  03200   ADA INSTRUCTION FAILED.                         00003610
*                                                          00003620
*  03210   SUA INSTRUCTION FAILED.                         00003630
*                                                          00003640
*  03225   STA INSTRUCTION FAILED.                         00003650
*                                                          00003660
*  03243   XMA INSTRUCTION FAILED.                         00003670
*                                                          00003680
*  03255   ADD INSTRUCTION FAILED.                         00003690
*                                                          00003700
*  03267   SUD INSTRUCTION FAILED.                         00003710
```

```
*                                                                    00003720
*       03304          STD INSTRUCTION FAILED.                       00003730
*                                                                    00003740
*       03321          XMD INSTRUCTION FAILED.                       00003750
*                                                                    00003760
*       03335          AMAG INSTRUCTION FAILED.                      00003770
*                                                                    00003780
*       03347          SMAG INSTRUCTIO  FAILED.                      0000379C
*                                                                    00003800
*       03364          JST INSTRUCTION FAILED.                       00003810
*                                                                    00003820
*       03374          JST INSTRUCTION FAILED.                       00003830
*                                                                    00003840
*       03406          LD INSTRUCTION FAILED.                        00003850
*                                                                    00003860
*       03472          DIJB INSTRUCTION FAILED.                      00003870
*                                                                    00003880
*       03513          DIJB INSTRUCTION FAILED.                      00003890
*                                                                    00003900
*       03524          DIJB INSTRUCTION FAILED.                      00003910
*                                                                    00003920
*       03532          IDX INSTRUCTION FAILED.                       00003930
*                                                                    00003940
*       03553          PZC FLIP-FLOP FAILED.                         00003950
*                                                                    00003960
*       03563          PZC FLIP-FLOP FAILED.                         00003970
*                                                                    00003980
*       04134          OCI, INSA, OR CP2 DEFECTIVE.                  00003990
*                                                                    00004000
*       04155          OTAR, OR INAS DEFECTIVE.                      00004010
*                                                                    00004020
*       04170          OIR DEFECTIVE.                                00004030
*                                                                    00004040
*       04210          OTAS DEFECTIVE.                               00004050
*                                                                    00004060
*       04227          OIS DEFECTIVE.                                00004070
*                                                                    00004080
*       04244          BOM DEFECTIVE.                                00004090
*                                                                    00004100
*       04263          SIM DEFECTIVE.                                00004110
*                                                                    00004120
*       04275          SIM, OR BOM ERROR.                            00004130
*                                                                    00004140
*       04313          BOM WITH OVERFLOW TERMINATION FAILED.         00004150
*                                                                    00004160
*       04337          SIM FAILED, ONE WORD SHOULD HAVE BEEN         00004170
*                      TRANSFERRED AND TERMINATED BY OVERFLOW.       00004180
*                                                                    00004190
*       04360          DMC WRITE FAILED.                             00004200
*                                                                    00004210
*       04410          ONLY ONE WORD SHOULD HAVE BEEN READ           00004220
*                      BY DMC READ OPERATION.                        00004230
*                                                                    00004240
*       04420          ONLY ONE WORD SHOULD HAVE BEEN                00004250
*                      TRANSFERRED DURING DMC READ.                  00004260
```

```
*                                                                       00004270
*       04425           I/O SIMULATOR TEST END.                         00004280
*                                                                       00004290
*       05162           MANUAL INTERRUPT LOGIC WORKS                    00004300
*                                                                       00004310
*       05220           DJ INDIRECT FAILED.                             00004320
*                                                                       00004330
*       05244           AMAG FAILED.                                    00004340
*                                                                       00004350
*       05300           ARS1 FAILED.                                    00004360
*                                                                       00004370
*       05315           ARS1 FAILED.                                    00004380
*                                                                       00004390
*       05332           ARS3 FAILED.                                    00004400
*                                                                       00004410
*       05347           ARS3 FAILED.                                    00004420
*                                                                       00004430
*       05370           SMAG FAILED.                                    00004440
*                                                                       00004450
*       05414           SMAG FAILED.                                    00004460
*                                                                       00004470
*       05435           JMI INSTRUCTION ERROR  A9 = 1.                  00004480
*                                                                       00004490
*       05445           JMI INSTRUCTION ERROR  A9 = 0.                  00004500
*                                                                       00004510
*       07621           CARRY LOOK-AHEAD LOGIC FAILED.                  00004520
*                                                                       00004530
*       07623           CARRY LOOK-AHEAD LOGIC FAILED.                  00004540
*                                                                       00004550
*       07625           CARRY LOOK-AHEAD LOGIC FAILED.                  00004560
*                                                                       00004570
*       07627           CARRY LOOK-AHEAD LOGIC FAILED.                  00004580
*                                                                       00004590
*       07631           CARRY LOOK-AHEAD LOGIC FAILED.                  00004600
*                                                                       00004610
*       07633           CARRY LOOK-AHEAD LOGIC FAILED.                  00004620
*                                                                       00004630
*       07635           CARRY LOOK-AHEAD LOGIC FAILED.                  00004640
*                                                                       00004650
*       07637           CARRY LOOK-AHEAD LOGIC FAILED.                  00004660
*                                                                       00004670
*       07641           CARRY LOOK-AHEAD LOGIC FAILED.                  00004680
**********************************************************************00004690
        EJT                                                             00004700
```

SECTION 6

DIAGNOSTIC LISTING

```
                        IDEN       INST
 00000          CPU     EQU        0
                *
                *       INSTRUCTION DIAGNOSTIC TEST
                *
                ***********************************************************************
00000  614 764          J     I    STESTP              PICK UP THE TEST NUMBER
00002  614 754  TEST1   J     I    P3ENT               GO TO P3 FOR JP TEST
00004  164 766  MPNT    JST   I    $HALT
00006  374              MIWA                           RESET MI2 F/F
00007  777              OCT        777
00010  560 770          STA        INTSTAT             SAVE INTERRUPT CONDITION
00012  034              EIA
00013  400              OCT        400
00014  012              ENI                            RESET INT3 F/F
00015  016              DSI                            DISARM INTERRUPT
00016  710 022          JNZ        RTCR
00020  704 004          JZE   I    MPNT
00022  440 770  RTCR    LA         INTSTAT
00024  034              EIA
00025  200              OCT        200
00026  012              ENI
00027  016              DSI
00030  704 004          JZE   I    MPNT
00032  164 766          JST   I    $HALT
00034  610 040  TJ      J          TLIA
00036  164 766  HJ      JST   I    $HALT               J FAILS
00040  020      TLIA    LIA
00041  001              OCT        1
00042  710 046          JNZ        TLIB
00044  164 766          JST   I    $HALT               LIA FAILS IF A_0
                *                                      JNZ FAILS OF A_1
00046  020      TLIB    LIA
00047  000              OCT        0
00050  022              LIB
00051  001              OCT        1
00052  001              CBA
00053  710 057          JNZ        TLIB2
00055  164 766          JST   I    $HALT               JNZ FAILS IF AB_001001
                *                                      CBA FAILS IF B_1, A.NE.1
                *                                      LIB FAILS OTHERWISE
00057  022      TLIB2   LIB                            ENSURE THAT LIB SETS ALL BITS
00060  777              OCT        777
00061  001              CBA
00062  034              EIA
00063  777              OCT        777
00064  710 070          JNZ        HLIB
00066  610 072          J          TZED
00070  164 766  HLIB    JST   I    $HALT               JNZ FAILS IF AB_000777 (OR J)
                *                                      EIA FAILS IF AB_777777
                *                                      LIB FAILS IF B.NE.777
                *                                      CBA OR EIA FAILS IF AB_XXX777
00072  022      TZED    LIB
00073  777              OCT        777
00074  001              CBA
```

```
00075  003                ZED                                                  00005260
00076  710 105            JNZ        HZED                                      00005270
00100  001                CBA                                                  00005280
00101  710 107            JNZ        HZED2                                     00005290
00103  610 111            J          TEIA                                      00005300
00105  164 766  HZED      JST   I    $HALT          ZED FAILS, A NOT 0         00005310
00107  164 766  HZED2     JST   I    $HALT          ZED FAILS, B NOT 0         00005320
00111  003      TEIA      ZED                                                  00005330
00112  034                EIA                       TEST EIA AGAIN             00005340
00113  252                OCT        252                                       00005350
00114  034                EIA                                                  00005360
00115  525                OCT        525                                       00005370
00116  034                EIA                                                  00005380
00117  777                OCT        777                                       00005390
00120  710 124            JNZ        HEIA                                      00005400
00122  610 126            J          TEIB                                      00005410
00124  164 766  HEIA      JST   I    $HALT          EIA FAILS IF A,NE,0        00005420
                *                                   JNZ OR J FAILS IF A_0      00005430
00126  003      TEIB      ZED                                                  00005440
00127  036                EIB                                                  00005450
00130  252                OCT        252                                       00005460
00131  036                EIB                                                  00005470
00132  525                OCT        525                                       00005480
00133  036                EIB                                                  00005490
00134  777                OCT        777                                       00005500
00135  020                LIA                                                  00005510
00136  777                OCT        777                                       00005520
00137  001                CBA                                                  00005530
00140  710 144            JNZ        HEIB                                      00005540
00142  610 146            J          TJZE                                      00005550
00144  164 766  HEIB      JST   I    $HALT          EIB FAILS IF A.NE.0        00005560
                *                                   JNZ OR J FAILS IF A_0      00005570
00146  022      TJZE      LIB                                                  00005580
00147  777                OCT        777                                       00005590
00150  020                LIA                                                  00005600
00151  000                OCT        0                                         00005610
00152  700 156            JZE        TJZED                                     00005620
00154  164 766  HJZE      JST   I    $HALT          JZE FAILS IF A_0           00005630
                *                                   JNZ FAILS IF A.NE.0        00005640
00156  022      TJZED     LIB                                                  00005650
00157  777                OCT        777                                       00005660
00160  001                CBA                       A_777 B_777                00005670
00161  003                ZED                                                  00005680
00162  740 166            JZED       TJZED2                                    00005690
00164  164 766  HJZED     JST   I    $HALT          JZED FAILS (AB_0)          00005700
00166  003      TJZED2    ZED                       TEST JZED FOR NO JUMP ONE BIT ON00005710
00167  020                LIA                                                  00005720
00170  400                OCT        400                                       00005730
00171  232      ROTAT     RLD1                      WILL ALSO TEST RLD1 PARTLY 00005740
00172  740 164            JZED       HJZED                                     00005750
00174  034                EIA                                                  00005760
00175  400                OCT        400                                       00005770
00176  700 204            JZE        TSRB1                                     00005780
00200  034                EIA                                                  00005790
00201  400                OCT        400                                       00005800
```

```
00202  610 171          J          ROTAT                              00005810
                        EUT                                           00005820
```

```
00204  022       TSRB1    LIB                                                  00005830
00205  525                 OCT        525                                       00005840
00206  200                 SRB1                                                 00005850
00207  036                 EIB                                                  00005860
00210  252                 OCT        252                                       00005870
00211  001                 CBA                                                  00005880
00212  700 216             JZE        TSRA1                                     00005890
00214  164 766   HSRB1     JST   I    $HALT              SRB1 FAILS             00005900
00216  020       TSRA1     LIA                                                  00005910
00217  525                 OCT        525                                       00005920
00220  201                 SRA1                                                 00005930
00221  034                 EIA                                                  00005940
00222  252                 OCT        252                                       00005950
00223  700 227             JZE        TSLA1                                     00005960
00225  164 766   HSRA1     JST   I    $HALT              SRA1 FAILS             00005970
00227  020       TSLA1     LIA                                                  00005980
00230  252                 OCT        252                                       00005990
00231  202                 SLA1                                                 00006000
00232  034                 EIA                                                  00006010
00233  524                 OCT        524                                       00006020
00234  700 240             JZE        TSLB1                                     00006030
00236  164 766   HSLA1     JST   I    $HALT              SLA1 FAILS             00006040
00240  022       TSLB1     LIB                                                  00006050
00241  252                 OCT        252                                       00006060
00242  020                 LIA                                                  00006070
00243  777                 OCT        777                                       00006080
00244  203                 SLB1                                                 00006090
00245  036                 EIB                                                  00006100
00246  524                 OCT        524                                       00006110
00247  034                 EIA                                                  00006120
00250  777                 OCT        777                                       00006130
00251  740 255             JZED       TSRB3                                     00006140
00253  164 766   HSLB1     JST   I    $HALT              SLB1 FAILS             00006150
00255  022       TSRB3     LIB                                                  00006160
00256  707                 OCT        707                                       00006170
00257  204                 SRB3                                                 00006180
00260  036                 EIB                                                  00006190
00261  070                 OCT        70                                        00006200
00262  700 267             JZE        TSRA3                                     00006210
00264  001                 CBA                                                  00006220
00265  164 766   HSRB3     JST   I    $HALT              SRB3 FAILS             00006230
00267  020       TSRA3     LIA                                                  00006240
00270  707                 OCT        707                                       00006250
00271  205                 SRA3                                                 00006260
00272  034                 EIA                                                  00006270
00273  070                 OCT        70                                        00006280
00274  700 300             JZE        TSLA3                                     00006290
00276  164 766   HSRA3     JST   I    $HALT              SRA3 FAILS             00006300
00300  020       TSLA3     LIA                                                  00006310
00301  070                 OCT        070                                       00006320
00302  206                 SLA3                                                 00006330
00303  034                 EIA                                                  00006340
00304  700                 OCT        700                                       00006350
00305  700 311             JZE        TSLB3                                     00006360
00307  164 766   HSLA3     JST   I    $HALT              SLA3 FAILS             00006370
```

```
00311  022        TSLB3   LIB                                                  00006380
00312  525                 OCT        525                                      00006390
00313  207                 SLB3                                                00006400
00314  036                 EIB                                                  00006410
00315  250                 OCT        250                                      00006420
00316  001                 CBA                                                  00006430
00317  700 323             JZE        TRRB1                                    00006440
00321  164 766    HSLB3   JST    I   $HALT              SLB3 FAILS             00006450
00323  022        TRRB1   LIB                                                  00006460
00324  077                 OCT        77                                       00006470
00325  210                 RRB1                                                00006480
00326  036                 EIB                                                  00006490
00327  437                 OCT        437                                      00006500
00330  001                 CBA                                                  00006510
00331  700 335             JZE        TRRA1                                    00006520
00333  164 766    HRRB1   JST    I   $HALT              RRB1 FAILS             00006530
00335  020        TRRA1   LIA                                                  00006540
00336  051                 OCT        51                                       00006550
00337  211                 RRA1                                                00006560
00340  034                 EIA                                                  00006570
00341  424                 OCT        424                                      00006580
00342  700 346             JZE        TRLA1                                    00006590
00344  164 766    HRRA1   JST    I   $HALT              RRA1 FAILS             00006600
00346  020        TRLA1   LIA                                                  00006610
00347  450                 OCT        450                                      00006620
00350  212                 RLA1                                                00006630
00351  034                 EIA                                                  00006640
00352  121                 OCT        121                                      00006650
00353  700 357             JZE        TRLB1                                    00006660
00355  164 766    HRLA1   JST    I   $HALT              RLA1 FAILS             00006670
00357  022        TRLB1   LIB                                                  00006680
00360  051                 OCT        51                                       00006690
00361  213                 RLB1                                                00006700
00362  036                 EIB                                                  00006710
00363  122                 OCT        122                                      00006720
00364  001                 CBA                                                  00006730
00365  700 371             JZE        TRRB3                                    00006740
00367  164 766    HRLB1   JST    I   $HALT              RLB1 FAILS             00006750
00371  022        TRRB3   LIB                                                  00006760
00372  245                 OCT        245                                      00006770
00373  214                 RRB3                                                00006780
00374  036                 EIB                                                  00006790
00375  524                 OCT        524                                      00006800
00376  001                 CBA                                                  00006810
00377  700 403             JZE        TRRA3                                    00006820
00401  164 766    HRRB3   JST    I   $HALT              RRB3 FAILS             00006830
00403  020        TRRA3   LIA                                                  00006840
00404  524                 OCT        524                                      00006850
00405  215                 RRA3                                                00006860
00406  034                 EIA                                                  00006870
00407  452                 OCT        452                                      00006880
00410  700 414             JZE        TRLA3                                    00006890
00412  164 766    HRRA3   JST    I   $HALT              RRA3 FAILS             00006900
00414  020        TRLA3   LIA                                                  00006910
00415  524                 OCT        524                                      00006920
```

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00416  216          RLA3                                          00006930
00417  034          EIA                                           00006940
00420  245          OCT      245                                  00006950
00421  700 425      JZE      TRLB3                                00006960
00423  164 766 HRLA3 JST   I  $HALT          RLA3-FAILS            0000697C
00425  022      TRLB3 LIB                                         00006980
00426  524          OCT      524                                  00006990
00427  217          RLB3                                          00007000
00430  036          EIB                                           00007010
00431  245          OCT      245                                  00007020
00432  001          CBA                                           00007030
00433  700 437      JZE      TSRD1                                00007040
00435  164 766 HRLB3 JST   I  $HALT          RLB3 FAILS            00007050
00437  020      TSRD1 LIA                                         00007060
00440  505          OCT      505                                  00007070
00441  022          LIB                                           00007080
00442  202          OCT      202                                  00007090
00443  220          SRD1                                          00007100
00444  034          EIA                                           00007110
00445  242          OCT      242                                  00007120
00446  036          EIB                                           00007130
00447  501          OCT      501                                  00007140
00450  740 454      JZED     TARS1                                00007150
00452  164 766 HSRD1 JST   I  $HALT          SRD1 FAILS            00007160
00454  020      TARS1 LIA                                         00007170
00455  505          OCT      505                                  00007180
00456  022          LIB                                           00007190
00457  202          OCT      202                                  00007200
00460  221          ARS1                                          00007210
00461  034          EIA                                           00007220
00462  642          OCT      642                                  00007230
00463  036          EIB                                           00007240
00464  501          OCT      501                                  00007250
00465  740 471      JZED     TSLD1                                00007260
00467  164 766 HARS1 JST   I  $HALT          ARS1 FAILS            00007270
00471  020      TSLD1 LIA                                         00007280
00472  505          OCT      505                                  00007290
00473  022          LIB                                           00007300
00474  202          OCT      202                                  00007310
00475  222          SLD1                                          00007320
00476  034          EIA                                           00007330
00477  212          OCT      212                                  00007340
00500  036          EIB                                           00007350
00501  404          OCT      404                                  00007360
00502  740 506      JZED     T223                                 00007370
00504  164 766 HSLD1 JST   I  $HALT          SLD1 FAILS            00007380
00506  610 523 T223  J        TSRD3          SKIP OP-CODE 223      00007390
00510  022          LIB                                           00007400
00511  202          OCT      202                                  00007410
00512  223          OCT      223            UNNAMED OP CODE 223   00007420
00513  034          EIA                                           00007430
00514  612          OCT      612                                  00007440
00515  036          EIB                                           00007450
00516  404          OCT      404                                  00007460
00517  740 523      JZED     TSRD3                                00007470
```

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00521  164 766  H223     JST   I   $HALT          OP CODE 223 FAILS          00007480
00523  020      TSRD3    LIA                                                 00007490
00524  505               OCT       505                                       00007500
00525  022               LIB                                                 00007510
00526  202               OCT       202                                       00007520
00527  224               SRD3                                                00007530
00530  036               EIB                                                 00007540
00531  520               OCT       520                                       00007550
00532  034               EIA                                                 00007560
00533  050               OCT       50                                        00007570
00534  740 540           JZED      TARS3                                     00007580
00536  164 766  HSRD3    JST   I   $HALT          SRD3 FAILS                 00007590
00540  020      TARS3    LIA                                                 00007600
00541  505               OCT       505                                       00007610
00542  022               LIB                                                 00007620
00543  202               OCT       202                                       00007630
00544  225               ARS3                                                00007640
00545  034               EIA                                                 00007650
00546  750               OCT       750                                       00007660
00547  036               EIB                                                 00007670
00550  520               OCT       520                                       00007680
00551  740 555           JZED      TSLD3                                     00007690
00553  164 766  HARS3    JST   I   $HALT          ARS3 FAILS                 00007700
00555  020      TSLD3    LIA                                                 00007710
00556  505               OCT       505                                       00007720
00557  022               LIB                                                 00007730
00560  202               OCT       202                                       00007740
00561  226               SLD3                                                00007750
00562  034               EIA                                                 00007760
00563  052               OCT       52                                        00007770
00564  036               EIB                                                 00007780
00565  020               OCT       20                                        00007790
00566  740 572           JZED      TSLD3B                                    00007800
00570  164 766  HSLD3    JST   I   $HALT          SLD3 FAILS - OP CODE 226   00007810
00572  610 607  TSLD3B   J         TRRD1          SKIP OP CODE 226           00007820
00574  022               LIB                                                 00007830
00575  202               OCT       202                                       00007840
00576  227               OCT       227            SLD3B CODE                 00007850
00577  034               EIA                                                 00007860
00600  052               OCT       52                                        00007870
00601  036               EIB                                                 00007880
00602  020               OCT       20                                        00007890
00603  740 607           JZED      TRRD1                                     00007900
00605  164 766  HSLD3B   JST   I   $HALT          SLD3 FAILS - OP CCDE 227   00007910
00607  020      TRRD1    LIA                                                 00007920
00610  505               OCT       505                                       00007930
00611  022               LIB                                                 00007940
00612  202               OCT       202                                       00007950
00613  230               RRD1                                                00007960
00614  034               EIA                                                 00007970
00615  242               OCT       242                                       00007980
00616  036               EIB                                                 00007990
00617  501               OCT       501                                       00008000
00620  740 624           JZED      T231                                      00008010
00622  164 766  HRRD1    JST   I   $HALT          RRD1 FAILS                 00008020
```

```
00624  610 656  T231     J          TRRD3          SKIP OP CODE 231 - 233
00626  022               LIB
00627  202               OCT        202
00630  231               OCT        231            OP CODE 231
00631  034               EIA
00632  642               OCT        642
00633  036               EIB
00634  501               OCT        501
00635  740 641           JZED       T233
00637  164 766  H231     JST   I    $HALT          OP CODE 231 FAILS
00641  020      T233     LIA
00642  505               OCT        505
00643  022               LIB
00644  202               OCT        202
00645  233               OCT        233            OP CODE 233
00646  034               EIA
00647  612               OCT        612
00650  036               EIB
00651  405               OCT        405
00652  740 656           JZED       TRRD3
00654  164 766  H233     JST   I    $HALT          OP CODE 233 FAILS
00656  020      TRRD3    LIA
00657  505               OCT        505
00660  022               LIB
00661  202               OCT        202
00662  234               RRD3
00663  034               EIA
00664  250               OCT        250
00665  036               EIB
00666  520               OCT        520
00667  740 673           JZED       T235
00671  164 766  HRRD3    JST   I    $HALT          RRD3 FAILS
00673  610 710  T235     J          TRLD3          SKIP OP CODE 235
00675  022               LIB
00676  202               OCT        202
00677  235               OCT        235            OP CODE 235
00700  034               EIA
00701  550               OCT        550
00702  036               EIB
00703  520               OCT        520
00704  740 710           JZED       TRLD3
00706  164 766  H235     JST   I    $HALT          OP CODE 235 FAILS
00710  020      TRLD3    LIA
00711  505               OCT        505
00712  022               LIB
00713  202               OCT        202
00714  236               RLD3
00715  034               EIA
00716  052               OCT        52
00717  036               EIB
00720  025               OCT        25
00721  740 725           JZED       TLDMC
00723  164 766  HRLD3    JST   I    $HALT          RLD3 FAILS
                         EJT
```

```
                  *                                                                  00008570
00725  414 756  TLDMC    LDMC  I   COUNT          LOAD DMC COUNT                     00008580
00727  414 760           LDMC  I   POINT          LOAD DMC POINTER                   00008590
00731  013               CDMC                                                        00008600
00732  034               EIA                                                         00008610
00733  077               OCT       077                                               00008620
00734  036               EIB                                                         00008630
00735  770               OCT       770                                               00008640
00736  740 742           JZED      TCDMC2                                            00008650
00740  164 766  HLDMC    JST   I   $HALT          LDMC OR CDMC FAILS                 00008660
00742  414 762  TCDMC2   LDMC  I   POINT2                                            00008670
00744  013               CDMC                                                        00008680
00745  744 752           JZED  I   ATMIB                                             00008690
00747  164 766  HCDMC2   JST   I   $HALT          CDMC FAILS                         00008700
00751  000               HALT                                                        00008710
00752  000 020  ATMIB    DAC       TMIB                                              00008720
00754  740 067  P3ENT    DAC       P3START                                           00008730
00756  770 007  COUNT    DAC       777B                                              00008740
00760  770 077  POINT    DAC       7777B                                             00008750
00762  000 000  POINT2   DAC       0                                                 00008760
00764  420 076  STESTP   DAC       STEST                                             00008770
00766  740 035  $HALT    DAC       HALT                                              00008780
00770  000      INTSTAT  OCT       0                                                 00008790
                         EJT                                                         00008800
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 02000                    ORG        2000B                                          00008810
02000  003       TMIB     ZED                                                      00008820
02001  022                LIB                                                      00008830
02002  777                OCT        777                                           00008840
02003  371                MIB                                                      00008850
02004  252                OCT        252                                           00008860
02005  036                EIB                                                      00008870
02006  252                OCT        252                                           00008880
02007  742 013            JZED       TMIB2                                         00008890
02011  164 766   HMIB     JST    I   $HALT              MIB FAILS                  00008900
02013  612 026   TMIB2    J          TMIA               SKIP OTHER MIB CODE        00008910
02015  777                OCT        777                                           00008920
02016  373                OCT        373                MIB2                       00008930
02017  525                OCT        525                                           00008940
02020  036                EIB                                                      00008950
02021  525                OCT        525                                           00008960
02022  742 026            JZED       TMIA                                          00008970
02024  164 766   HMIB2    JST    I   $HALT              MIB2 FAILS                 00008980
02026  020       TMIA     LIA                                                      00008990
02027  777                OCT        777                                           00009000
02030  370                MIA                                                      00009010
02031  252                OCT        252                                           00009020
02032  034                EIA                                                      00009030
02033  252                OCT        252                                           00009040
02034  702 040            JZE        TCAB                                          00009050
02036  164 766   HMIA     JST    I   $HALT              MIA FAILS                  00009060
02040  022       TCAB     LIB                                                      00009070
02041  777                OCT        777                                           00009080
02042  020                LIA                                                      00009090
02043  000                OCT        0                                             00009100
02044  002                CAB                                                      00009110
02045  742 051            JZED       TPCKA                                         00009120
02047  164 766   HCAB     JST    I   $HALT              CAB FAILS                  00009130
02051  020       TPCKA    LIA                                                      00009140
02052  770                OCT        770                                           00009150
02053  004                PCKA                                                     00009160
02054  034                EIA                                                      00009170
02055  770                OCT        770                                           00009180
02056  702 062            JZE        TPCKA2                                        00009190
02060  164 766   HPCKA    JST    I   $HALT              PCKA FAILS ON BITS 4-9 SET 00009200
02062  020       TPCKA2   LIA                                                      00009210
02063  017                OCT        17                 EVEN ONES  A9 SHOULD CHANGE 00009220
02064  004                PCKA                                                     00009230
02065  034                EIA                                                      00009240
02066  417                OCT        417                                           00009250
02067  702 073            JZE        TCOMA                                         00009260
02071  164 766   HPCKA4   JST    I   $HALT              PCKA FAILS ON BITS 1-4 SET 00009270
02073  020       TCOMA    LIA                                                      00009280
02074  777                OCT        777                                           00009290
02075  005                COMA                                                     00009300
02076  034                EIA                                                      00009310
02077  001                OCT        1                                             00009320
02100  702 104            JZE        TEAB                                          00009330
02102  164 766   HCOMA    JST    I   $HALT              COMA FAILS                 00009340
02104  020       TEAB     LIA                                                      00009350
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02105  525                 OCT        525                                    00009360
02106  022                 LIB                                               00009370
02107  252                 OCT        252                                    00009380
02110  006                 EAB                                               00009390
02111  036                 EIB                                               00009400
02112  777                 OCT        777                                    00009410
02113  001                 CBA                                               00009420
02114  702 120             JZE        TNOOP                                  00009430
02116  164 766   HEAB      JST   I    $HALT                                  00009440
  02120          TNOOP     EQU        *                                      00009450
02120  020       TXAB      LIA                                               00009460
02121  252                 OCT        252                                    00009470
02122  022                 LIB                                               00009480
02123  525                 OCT        525                                    00009490
02124  011                 XAB                                               00009500
02125  034                 EIA                                               00009510
02126  525                 OCT        525                                    00009520
02127  036                 EIB                                               00009530
02130  252                 OCT        252                                    00009540
02131  742 135             JZED       TCOMD                                  00009550
02133  164 766   HXAB      JST   I    $HALT              XAB FAILS           00009560
02135  020       TCOMD     LIA                                               00009570
02136  252                 OCT        252                                    00009580
02137  022                 LIB                                               00009590
02140  525                 OCT        525                                    00009600
02141  014                 COMD                                              00009610
02142  034                 EIA                                               00009620
02143  525                 OCT        525                                    00009630
02144  036                 EIB                                               00009640
02145  253                 OCT        253                                    00009650
02146  742 152             JZED       TCOMB                                  00009660
02150  164 766   HCOMD     JST   I    $HALT              COMD FAILS          00009670
02152  003       TCOMB     ZED                                               00009680
02153  022                 LIB                                               00009690
02154  525                 OCT        525                                    00009700
02155  015                 COMB                                              00009710
02156  036                 EIB                                               00009720
02157  253                 OCT        253                                    00009730
02160  742 164             JZED       TLIAX                                  00009740
02162  164 766   HCOMB     JST   I    $HALT              COMB FAILS          00009750
02164  003       TLIAX     ZED                                               00009760
02165  021                 LIA    X                      A_777 BECAUSE A9 WAS OFF 00009770
02166  777                 OCT        777                                    00009780
02167  077                 OCT        077                                    00009790
02170  021                 LIA    X                      A_0 BECAUSE A9 WAS ON 00009800
02171  777                 OCT        777                                    00009810
02172  000                 OCT        0                                      00009820
02173  742 177             JZED       TLIBX                                  00009830
02175  164 766   HLIAX     JST   I    $HALT              LIAX FAILS          00009840
02177  003       TLIBX     ZED                                               00009850
02200  023                 LIB    X                      B_777 BECAUSE A9 WAS OFF 00009860
02201  777                 OCT        777                                    00009870
02202  000                 OCT        0                                      00009880
02203  001                 CBA                           SET A9 ON           00009890
02204  023                 LIB    X                      B_0 BECAUSE A9 WAS ON 00009900
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02205  777                 OCT        777                                                  00009910
02206  000                 OCT        0                                                    00009920
02207  001                 CBA                        A_B_0                                00009930
02210  742 214             JZED       TAIA                                                 00009940
02212  164 766  HLIBX      JST   I    $HALT           LIBX FAILS                           00009950
02214  003      TAIA       ZED                                                             00009960
02215  024                 AIA                        ADD 111 TO A BECAUSE A9 WAS OFF      00009970
02216  111                 OCT        111                                                  00009980
02217  024                 AIA                        A_111+667_1000                       00009990
02220  667                 OCT        667                                                  00010000
02221  742 225             JZED       TAIAX                                                00010010
02223  164 766  HAIA       JST   I    $HALT           AIA FAILS                            00010020
02225  003      TAIAX      ZED                                                             00010030
02226  025                 AIA    X                   ADD 705 TO A BECAUSE A9 WAS OFF      00010040
02227  705                 OCT        705                                                  00010050
02230  000                 OCT        0                                                    00010060
02231  025                 AIA    X                   ADD 73 TO A BECAUSE A9 WAS ON        00010070
02232  000                 OCT        0                                                    00010080
02233  073                 OCT        73                                                   00010090
02234  742 240             JZED       TAIB                                                 00010100
02236  164 766  HAIAX      JST   I    $HALT           AIAX FAILS                           00010110
02240  003      TAIB       ZED                                                             00010120
02241  026                 AIB                                                             00010130
02242  136                 OCT        136                                                  00010140
02243  026                 AIB                        B_136+642_1000                       00010150
02244  642                 OCT        642                                                  00010160
02245  742 251             JZED       TAIBX                                                00010170
02247  164 766  HAIB       JST   I    $HALT           AIB FAILS                            00010180
02251  003      TAIBX      ZED                                                             00010190
02252  027                 AIB    X                   ADD 702 TO B BECAUSE A9 WAS OFF      00010200
02253  702                 OCT        702                                                  00010210
02254  137                 OCT        137                                                  00010220
02255  001                 CBA                        SET A9 ON                            00010230
02256  027                 AIB    X                   ADD 76 TO 702 BECAUSE A9 WAS ON      00010240
02257  252                 OCT        252                                                  00010250
02260  076                 OCT        76                                                   00010260
02261  001                 CBA                        A_B_0                                00010270
02262  742 266             JZED       TEAI                                                 00010280
02264  164 766  HAIBX      JST   I    $HALT           AIBX FAILS                           00010290
02266  020      TEAI       LIA                                                             00010300
02267  707                 OCT        707                                                  00010310
02270  562 273             STA        SEAI                                                 00010320
02272  030                 EAI                                                             00010330
02273  707      SEAI       OCT        707                                                  00010340
02274  442 273             LA         SEAI            LOAD EXORED RESULT IN A              00010350
02276  702 302             JZE        TEAIX                                                00010360
02300  164 766  HEAI       JST   I    $HALT           EAI FAILS OR LA FAILS                00010370
02302  020      TEAIX      LIA                                                             00010380
02303  525                 OCT        525                                                  00010390
02304  562 310             STA        SEAIX                                                00010400
02306  031                 EAI    X                                                        00010410
02307  525                 OCT        525                                                  00010420
02310  525      SEAIX      OCT        525                                                  00010430
02311  442 310             LA         SEAIX                                                00010440
02313  702 317             JZE        TEBI                                                 00010450
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02315  164 766  HEAIX   JST   I    $HALT          EAIX FAILS IF SEAIX NOT ZERO    00010460
                *                                 ELSE LA OR JZE FAILS            00010470
02317  022      TEBI    LIB                                                      00010480
02320  707              OCT         707                                         00010490
02321  522 324          STB         SEBI                                        00010500
02323  032              EBI                                                      00010510
02324  707      SEBI    OCT         707                                         00010520
02325  442 324          LA          SEBI           LOAD EXORED RESULT IN A      00010530
02327  702 333          JZE         TEBIX                                       00010540
02331  164 766  HEBI    JST   I     $HALT          EBI FAILS                    00010550
02333  022      TEBIX   LIB                                                      00010560
02334  452              OCT         452                                         00010570
02335  001              CBA                        SET A9 ON                    00010580
02336  562 342          STA         SEBIX                                       00010590
02340  033              EBI    X                                                00010600
02341  452              OCT         452                                         00010610
02342  452      SEBIX   OCT         452                                         00010620
02343  442 342          LA          SEBIX                                       00010630
02345  702 351          JZE         TEIAX                                       00010640
02347  164 766  HEBIX   JST   I     $HALT          EBIX FAILS                   00010650
02351  020      TEIAX   LIA                        A _444 AND A9_1              00010660
02352  444              OCT         444                                         00010670
02353  035              EIA    X                   EXORE A WITH 444 BECAUSE A9=1 00010680
02354  333              OCT         333                                         00010690
02355  444              OCT         444                                         00010700
02356  702 362          JZE         TEIBX                                       00010710
02360  164 766  HEIAX   JST   I     $HALT          EIAX FAILS                   00010720
02362  022      TEIBX   LIB                                                      00010730
02363  333              OCT         333                                         00010740
02364  001              CBA                                                      00010750
02365  037              EIB    X                                                00010760
02366  333              OCT         333                                         00010770
02367  444              OCT         444                                         00010780
02370  001              CBA                        A_B_0                        00010790
02371  702 375          JZE         TDJ            STEST                        00010800
02373  164 766  HEIBX   JST   I     $HALT          EIBX FAILS                   00010810
                EJT                                                           00010820
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02375  003       TDJ      ZED                                                          00010830
02376  602 404            DJ          HDJ                  I_0, INDEXED BIT OFF        00010840
                 * THE INSTRUCTION ACTS AS A NOOP INST. AND THE NEXT INSTRUCTION IS PICKE00010850
                 *UP FROM M 2.                                                         00010860
02400  020                LIA                                                          00010870
02401  700                OCT         700                                              00010880
02402  603 404            DJ      X   HDJ                  I_0, INDEXED BIT IS ON      00010890
                 *THE DJ INSTRUCTION IN THIS CASE ACTS AS NOOP INSTRUCTION AND THE NEXT 00010900
                 * INSTRUCTION IS PICKED UP FROM M 4.                                  00010910
02404  164 766   HDJ      JST    I    $HALT                DJ FAILS                    00010920
02406  020                LIA                                                          00010930
02407  777                OCT         777                                              00010940
                 ***********************************************************************00010950
                 * WHEN DJ INSTRUCTION IS EXECUTED AT LOCATION 02410, THE NEXT INSTRUCTI00010960
                 * PICKED FROM 02414 BECAUSE A9 AND THE INDEXED BITS ARE ON. SINCE DURING00010970
                 * THE CONTENTS OF LOCATION 02414 WERE MODIFIED AS:                    00010980
                 *              MB_MB 020_022                                          00010990
                 *THE INSTRUCTION AT LOCATION 02414 NOW IS LIB, NOT CAB.               00011000
                 ***********************************************************************00011010
02410  607 412            DJ     IX   DJ1                                              00011020
02412  000 000   DJ1      DAC         0                                                00011030
02414  002       DJ2      CAB                              DJ MAKES CAB%002) INT LIB%022) 00011040
02415  002                OCT         2                                                00011050
02416  522 414            STB         DJ2                                              00011060
02420  036                EIB                                                          00011070
02421  002                OCT         2                                                00011080
02422  001                CBA                                                          00011090
02423  742 427            JZED        TJOV                                             00011100
02425  164 766   HDJ2     JST    I    $HALT                DJ FAILS TO AUTO-INDEX      00011110
                 ***********************************************************************00011120
                 *  OPERATION COMMON TO ALL JUMP INSTRUCTIONS                          00011130
                 ***********************************************************************00011140
                 *  1) I4 FLIP-FLOP IS CLEARED AT F1T1 TIME PRIOR TO INSTRUCTION LOAD.  00011150
                 *  2)  AT F1T2 TIME I4 F/F IS SET DEPENDING ON WHETHER THE INSTRUCTION 00011160
                 *    OP-CODE HAS I4 BIT ON OR OFF.                                    00011170
                 *  3)  AT F1T4 THE I4 F/F IS TOGGLED. IF THE I4 F/F IS OFF WE HAVE A FAL00011180
                 *      CONDITION, OTHERWISE A JUMP CONDITION.                         00011190
02427  020       TJOV     LIA                              OV FLIP-FLOP IS SET         00011200
02430  400                OCT         400                  -256 DECIMAL                00011210
02431  024                AIA                                                          00011220
02432  777                OCT         777                   -1 DECIMAL                 00011230
02433  622 437            JOV         TJOV2                I4 ON, JUMP CONDITION       00011240
02435  164 766   HJOV     JST    I    $HALT                JOV FAILS IF A_377 OV SET   00011250
02437  020       TJOV2    LIA                                                          00011260
02440  400                OCT         400                  -256 DECIMAL                00011270
02441  024                AIA                                                          00011280
02442  377                OCT         377                  +255 DECIMAL                00011290
02443  622 447            JOV         HJOV2                I4 OFF, FALL THRU           00011300
02445  612 451            J           TJOV3                                            00011310
02447  164 766   HJOV2    JST    I    $HALT                                            00011320
02451  020       TJOV3    LIA                               OV F/F WILL BE SET         00011330
02452  377                OCT         377                                              00011340
02453  024                AIA                                                          00011350
02454  377                OCT         377                                              00011360
02455  622 461            JOV         TJNOV                 I4 F/F IS ON, JUMP         00011370
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02457  164 766  HJOV3    JST   I     $HALT          JOV FAILS ON OVERFLOW                00011380
02461  020      TJNOV    LIA                                                             00011390
02462  400               OCT         400                                                00011400
02463  024               AIA                                                             00011410
02464  377               OCT         377                                                00011420
02465  632 471           JNOV        TJNOV2          I4 F/F REMAIN ON, JUMP             00011430
02467  164 766  HJNOV    JST   I     $HALT          JNOV FAILS  OV NOT SET              00011440
02471  020      TJNOV2   LIA                                                             00011450
02472  400               OCT         400                                                00011460
02473  024               AIA                                                             00011470
02474  400               OCT         400                                                00011480
02475  632 501           JNOV        HJNOV2         OV IS SET. I4 TOGGLED OFF AT        00011490
                *F1T4. FALL-THROUGH CONDITION.                                          00011500
02477  612 503           J           TJMI                                                00011510
02501  164 766  HJNOV2   JST   I     $HALT          JNOV FAILS  OV SET                  00011520
02503  020      TJMI     LIA                        SET SIGN BIT ON                     00011530
02504  777               OCT         777                                                00011540
02505  642 511           JMI         TJMI2          I4 TOGGLED ON AT F1T4. JUMP         00011550
02507  164 766  HJMI     JST   I     $HALT          JMI FAILS ON MINUS                  00011560
02511  020      TJMI2    LIA                                                             00011570
02512  356               OCT         356                                                00011580
02513  642 517           JMI         HJMI2          I4 IS OFF. FALL THRU                00011590
02515  612 521           J           TJPL                                                00011600
02517  164 766  HJMI2    JST   I     $HALT          JMI FAILS ON PLUS                   00011610
02521  020      TJPL     LIA                                                             00011620
02522  777               OCT         777                                                00011630
02523  652 527           JPL         HJPL           I4 TOGGLED OFF AT F1T4. FALL TH     00011640
02525  612 531           J           TJPL2                                               00011650
02527  164 766  HJPL     JST   I     $HALT          JPL FAILS ON MINUS                  00011660
02531  020      TJPL2    LIA                                                             00011670
02532  377               OCT         377                                                00011680
02533  652 537           JPL         TJOD           I4 REMAIN ON AT F1T4. JUMP          00011690
02535  164 766  HJPL2    JST   I     $HALT          JPL FAILS ON PLUS                   00011700
02537  020      TJOD     LIA                        SET A1 ON                           00011710
02540  001               OCT         1                                                  00011720
02541  662 545           JOD         TJOD2          I4 TOGGLED ON AT F1T4. JUMP         00011730
02543  164 766  HJOD     JST   I     $HALT          JOD FAILS ON ODD                    00011740
02545  003      TJOD2    ZED                        TURN OFF A1                         00011750
02546  662 552           JOD         HJOD2          I4 OFF AT  T1F4. FALL THRU          00011760
02550  612 554           J           TJEV                                                00011770
02552  164 766  HJOD2    JST   I     $HALT          JOD FAILS ON EVEN                   00011780
02554  003      TJEV     ZED                        SET A1 OFF                          00011790
02555  672 561           JEV         TJEV2          I4 REMAIN ON AT F1T4. JUMP          00011800
02557  164 766  HJEV     JST   I     $HALT          JEV FAILS ON EVEN                   00011810
02561  020      TJEV2    LIA                        SET A1 ON                           00011820
02562  001               OCT         1                                                  00011830
02563  672 567           JEV         HJEV2          I4 TOGGLED OFF. FALL THRU           00011840
02565  612 571           J           TJODD                                               00011850
02567  164 766  HJEV2    JST   I     $HALT          JEV FAILS ON ODD                    00011860
02571  022      TJODD    LIB                        SET B1 ON                           00011870
02572  001               OCT         1                                                  00011880
02573  722 577           JODD        TJODD2         I4 TOGGLED ON AT F1T4. JUMP         00011890
02575  164 766  HJODD    JST   I     $HALT          JODD FAILS ON ODD                   00011900
02577  003      TJODD2   ZED                        SET B1 OFF                          00011910
02600  722 604           JODD        HJODD2         I4 REMAIN OFF AT F1T4. FALL THRU00011920
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02602  612 606            J          TJEVD                                          00011930
02604  164 766  HJODD2    JST    I   $HALT          JODD FAILS ON EVEN              00011940
02606  003      TJEVD     ZED                      SET B1 OFF                      00011950
02607  732 613            JEVD       TJEVD2          I4 REMAIN ON AT FIT4. JUMP     00011960
02611  164 766  HJEVD     JST    I   $HALT          JEVD FAILS ON EVEN              00011970
02613  022      TJEVD2    LIB                      SET B1 ON                       00011980
02614  001                OCT        1                                              00011990
02615  732 621            JEVD       HJEVD2         I4 TOGGLED OFF. FALL THRU       00012000
02617  612 623            J          TJNZD                                          00012010
02621  164 766  HJEVD2    JST    I   $HALT          JEVD FAILS ON ODD               00012020
02623  003      TJNZD     ZED                      SET A_B_0                       00012030
02624  752 630            JNZD       HJNZD          I4 TOGGLED OFF. FALL THRU       00012040
02626  612 632            J          TJNZD2                                         00012050
02630  164 766  HJNZD     JST    I   $HALT          JNZD FAILS ON ZERO              00012060
02632  022      TJNZD2    LIB                      MAKE AB NON-ZERO                00012070
02633  001                OCT        1                                              00012080
02634  752 640            JNZD       TJCT           I4 REMAIN ON. JUMP              00012090
02636  164 766  HJNZD2    JST    I   $HALT          JNZD FAILS ON NON-ZERO          00012100
02640  020      TJCT      LIA                                                       00012110
02641  777                OCT        777                                            00012120
02642  024                AIA                      CTP F/F IS SET                  00012130
02643  377                OCT        377             K09T ON                        00012140
02644  762 650            JCT        TJCT2           I4 TOGGLED ON. JUMP            00012150
02646  164 766  HJCT      JST    I   $HALT          JCT FAILS WITH CT SET           00012160
02650  024      TJCT2     AIA                       K09T OFF                       00012170
02651  377                OCT        377                                            00012180
02652  762 656            JCT        HJCT2           I4 REMAINS OFF. FALL THRU      00012190
02654  612 660            J          TJNCT2                                         00012200
02656  164 766  HJCT2     JST    I   $HALT          JCT FAILS WITH CT NOT SET       00012210
02660  020      TJNCT2    LIA                                                       00012220
02661  777                OCT        777                                            00012230
02662  024                AIA                      K09T ON. CTP SET                00012240
02663  377                OCT        377                                            00012250
02664  772 670            JNCT       HJNCT2         I4 TOGGLED OFF. FALL THRU       00012260
02666  612 672            J          TJNCT3                                         00012270
02670  164 766  HJNCT2    JST    I   $HALT          JNCT FAILS ON CT SET            00012280
02672  024      TJNCT3    AIA                                                       00012290
02673  377                OCT        377                                            00012300
02674  772 700            JNCT       TLB                                            00012310
02676  164 766  HJNCT3    JST    I   $HALT          JNCT FAILS ON CT NOT SET        00012320
                          EJT                                                       00012330
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02700  402 703  TLB     LB        SLB                                          00012340
02702  036              EIB                                                    00012350
02703  525      SLB     OCT       525                                          00012360
02704  001              CBA                                                    00012370
02705  742 711          JZED      TDRS                                         00012380
02707  164 766  HLB     JST   I   $HALT          LB FAILS                      00012390
02711  020      TDRS    LIA                                                    00012400
02712  001      ONE     OCT       1                                            00012410
02713  562 725          STA       SDRS                                         00012420
02715  422 725          DRS       SDRS           CTI TOGGLED OFF WITH K09T AT  00012430
               *                                F1T3                          00012440
02717  422 725          DRS       SDRS           CTI REMAIN SET. THERFORE SKIP 00012450
02721  164 766  HDRS    JST   I   $HALT          DRS FAILS                     00012460
02723  612 726          J         TRLM1                                        00012470
02725  001      SDRS    OCT       1                                            00012480
02726  432 745  TRLM1   RLM1      SLC            SLC NOW EQUALS 253            00012490
02730  402 745          LB        SLC                                          00012500
02732  020              LIA                                                    00012510
02733  525              OCT       525                                          00012520
02734  562 745          STA       SLC            RESTORE 525 IN SLC            00012530
02736  036              EIB                                                    00012540
02737  253              OCT       253                                          00012550
02740  001              CBA                                                    00012560
02741  746 746          JZED  I   ATLA                                         00012570
02743  164 766  HRLM1   JST   I   $HALT                                        00012580
02745  525      SLC     OCT       525                                          00012590
02746  070 030  ATLA    DAC       TLA                                          00012600
  03007                ORG       3007B                                        00012610
03007  003      TLA     ZED                      CLEAR A                       00012620
03010  020              LIA                                                    00012630
03011  777              OCT       777                                          00012640
03012  442 071          LA        START          LOAD A WITH 000               00012650
03014  742 020          JZED      TSUBA                                        00012660
03016  164 766          JST   I   $HALT          LA FAILS                      00012670
03020  003      TSUBA   ZED                                                    00012680
03021  452 563          SUBA      ONE2           ONE2_1; B_0;0-1_-1_777 OCTAL  00012690
03023  034              EIA                                                    00012700
03024  777              OCT       777                                          00012710
03025  742 034          JZED      TIRS                                         00012720
03027  164 766  HSUBA   JST   I   $HALT          SUBA FAILS                    00012730
03031  612 034          J         TIRS                                         00012740
03033  776      SIRS    OCT       776                                          00012750
03034  020      TIRS    LIA                                                    00012760
03035  776              OCT       776            -2 DECIMAL                    00012770
03036  562 033          STA       SIRS                                         00012780
03040  462 033          IRS       SIRS           SIRS_+1-2_-1DECIMAL; DONOT SKIP 00012790
03042  462 033          IRS       SIRS           SIRS_+1-1_0, THEREFORE SKIP   00012800
03044  164 766  HIRS    JST   I   $HALT          IRS FAILS                     00012810
03046  402 033          LB        SIRS           CHECK SIRS FOR ZERO           00012820
03050  001              CBA                      A_B_0                         00012830
03051  742 055          JZED      TSTZ                                         00012840
03053  164 766          JST   I   $HALT          IRS FAILS                     00012850
03055  020      TSTZ    LIA                                                    00012860
03056  777              OCT       777                                          00012870
03057  562 071          STA       START                                        00012880
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03061  472 071          STZ        START              PUT A HALT IN 0
03063  442 071          LA         START
03065  702 072          JZE        TADB
03067  164 766  HSTZ    JST   I    $HALT              STZ FAILS OR STA FAILS
03071  000      START   OCT        0
03072  022      TADB    LIB
03073  001              OCT        1
03074  502 056          ADB        TSTZ+1             777+1_1000
03076  001              CBA
03077  742 103          JZED       TSUB
03101  164 766  HADB    JST   I    $HALT              ADB FAILS
03103  022      TSUB    LIB
03104  777              OCT        777
03105  512 056          SUB        TSTZ+1
03107  001              CBA
03110  742 114          JZED       TSTB
03112  164 766  HSUB    JST   I    $HALT              SUB FAILS
03114  022      TSTB    LIB
03115  777              OCT        777
03116  522 121          STB        SSTB
03120  036              EIB
03121  000      SSTB    OCT        0
03122  472 121          STZ        SSTB
03124  001              CBA
03125  742 131          JZED       TXMB
03127  164 766  HSTB    JST   I    $HALT              STB FAILS
                ***********************************************************************
                *  XMB INSTRUCTION ALSO CHECKS THE GOODIE REGISTER THOROUGHLY.
                ***********************************************************************
03131  472 142  TXMB    STZ        SXMB               SXMB_0
03133  022              LIB
03134  777              OCT        777
03135  532 142          XMB        SXMB               B_0; SXMB_777; G_0
03137  020              LIA
03140  777              OCT        777
03141  034              EIA
03142  777      SXMB    OCT        777                A_0
03143  742 147          JZED       TXMB2
03145  164 766  HXMB    JST   I    $HALT              CHECK G_0
03147  022      TXMB2   LIB
03150  777              OCT        777
03151  522 166          STB        SXMB2
03153  003              ZED
03154  532 166          XMB        SXMB2              B_G_777; SXMB2_0
03156  442 166          LA         SXMB2              A_0
03160  036              EIB
03161  777              OCT        777
03162  742 167          JZED       TADA
03164  164 766          JST   I    $HALT              CHECK FOR G_777
03166  000      SXMB2   OCT        0
03167  020      TADA    LIA
03170  432              OCT        432
03171  005              COMA
03172  542 170          ADA        TADA+1
03174  702 200          JZE        TSUA
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03176  164 766  HADA    JST   I   $HALT          ADA FAILS                  00013440
03200  020      TSUA    LIA                                                 00013450
03201  777              OCT       777                                       00013460
03202  552 201          SUA       TSUA+1                                    00013470
03204  702 210          JZE       TSTA                                      00013480
03206  164 766  HSUA    JST   I   $HALT          SUA FAILS                  00013490
03210  020      TSTA    LIA                                                 00013500
03211  123              OCT       123                                       00013510
03212  562 216          STA       RSTA                                      00013520
03214  005              COMA                                                00013530
03215  024              AIA                                                 00013540
03216  000      RSTA    OCT       0                                         00013550
03217  472 216          STZ       RSTA                                      00013560
03221  702 225          JZE       TXMA                                      00013570
03223  164 766  HSTA    JST   I   $HALT          STA FAILS                  00013580
03225  472 236  TXMA    STZ       SXMA                                      00013590
03227  020              LIA                                                 00013600
03230  525              OCT       525                                       00013610
03231  002              CAB                                                 00013620
03232  005              COMA                                                00013630
03233  572 236          XMA       SXMA           A_0; SXMA_253              00013640
03235  026              AIB                       B_525+253_0               00013650
03236  000      SXMA    OCT       0                                         00013660
03237  742 243          JZED      TADD                                      00013670
03241  164 766  HXMA    JST   I   $HALT          XMA FAILS                  00013680
03243  020      TADD    LIA                                                 00013690
03244  757              OCT       757                                       00013700
03245  022              LIB                                                 00013710
03246  021              OCT       21                                        00013720
03247  102 243          ADD       TADD           LIA OP CODE MUST BE 020    00013730
03251  742 255          JZED      TSUD           AB_757021+020577_0         00013740
03253  164 766  HADD    JST   I   $HALT          ADD FAILS                  00013750
03255  020      TSUD    LIA                                                 00013760
03256  020              OCT       020                                       00013770
03257  022              LIB                                                 00013780
03260  020              OCT       020                                       00013790
03261  112 255          SUD       TSUD           AB_020020-020020_0         00013800
03263  742 267          JZED      TSTD                                      00013810
03265  164 766  HSUD    JST   I   $HALT          SUD FAILS                  00013820
03267  003      TSTD    ZED                                                 00013830
03270  562 300          STA       JSTD                                      00013840
03272  020              LIA                                                 00013850
03273  612              OCT       612                                       00013860
03274  022              LIB                                                 00013870
03275  304              SAC       TXMD                                      00013880
03276  122 300          STD       JSTD                                      00013890
03300  000 000  JSTD    OCTD      0                                         00013900
03302  164 766  HSTD    JST   I   $HALT          STD FAILS                  00013910
03304  003      TXMD    ZED                                                 00013920
03305  122 315          STD       JXMD                                      00013930
03307  020              LIA                                                 00013940
03310  612              OCT       612                                       00013950
03311  022              LIB                                                 00013960
03312  321              SAC       TAMAG                                     00013970
03313  132 315          XMD       JXMD                                      00013980
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03315  000 000  JXMD    OCTD      0                                          00013990
03317  164 766  HXMD    JST   I   $HALT          XMD FAILS                   00014000
03321  020      TAMAG   LIA                                                  00014010
03322  420              OCT       420                                        00014020
03323  022              LIB                                                  00014030
03324  420              OCT       420                                        00014040
03325  142 321          AMAG      TAMAG                                      00014050
03327  034              EIA                                                  00014060
03330  400              OCT       400                                        00014070
03331  742 335          JZED      TSMAG                                      00014080
03333  164 766          JST   I   $HALT          AMAG FAILS                  00014090
03335  020      TSMAG   LIA                                                  00014100
03336  757              OCT       757                                        00014110
03337  022              LIB                                                  00014120
03340  021              OCT       021                                        00014130
03341  152 335          SMAG      TSMAG                                      00014140
03343  742 347          JZED      TJST                                       00014150
03345  164 766  HSMAG   JST   I   $HALT          SMAG FAILS                  00014160
03347  162 366  TJST    JST       SJST                                       00014170
03351  442 366          LA        SJST                                       00014180
03353  402 367          LB        SJST+1                                     00014190
03355  234              RRD3                                                 00014200
03356  034              EIA                                                  00014210
03357  351              SAC       TJST+2                                     00014220
03360  702 374          JZE       TLD                                        00014230
03362  164 766  HJST    JST   I   $HALT          JST FAILS                   00014240
03364  612 374          J         TLD                                        00014250
03366  000 000  SJST    OCTD      0                                          00014260
03370  616 366          J     I   SJST                                       00014270
03372  164 766          JST   I   $HALT          JST FAILS                   00014280
03374  172 374  TLD     LD        *                                          00014290
03376  034              EIA                                                  00014300
03377  172              OCT       172                                        00014310
03400  036              EIB                                                  00014320
03401  374              SAC       TLD                                        00014330
03402  742 406          JZED      TDIJB                                      00014340
03404  164 766  HLD     JST   I   $HALT          LD FAILS                    00014350
03406  022      TDIJB   LIB                                                  00014360
03407  001              OCT       1                                          00014370
03410  612 461          J         DDIJB                                      00014380
03412  442 461  DECR    LA        DDIJB          MUST BE AT 3007             00014390
03414  552 563          SUA       ONE2                                       00014400
03416  562 461          STA       DDIJB                                      00014410
03420  612 461          J         DDIJB                                      00014420
03422  213              RLB1                                                 00014430
03423  213              RLB1                                                 00014440
03424  213              RLB1                                                 00014450
03425  213              RLB1                                                 00014460
03426  213              RLB1                                                 00014470
03427  213              RLB1                                                 00014480
03430  213              RLB1                                                 00014490
03431  213              RLB1                                                 00014500
03432  213              RLB1                                                 00014510
03433  213              RLB1                                                 00014520
03434  213              RLB1                                                 00014530
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03435  213                RLB1                                                  00014540
03436  213                RLB1                                                  00014550
03437  213                RLB1                                                  00014560
03440  213                RLB1                                                  00014570
03441  213                RLB1                                                  00014580
03442  213                RLB1                                                  00014590
03443  213                RLB1                                                  00014600
03444  213                RLB1                                                  00014610
03445  213                RLB1                                                  00014620
03446  213                RLB1                                                  00014630
03447  213                RLB1                                                  00014640
03450  213                RLB1                                                  00014650
03451  213                RLB1                                                  00014660
03452  213                RLB1                                                  00014670
03453  213                RLB1                                                  00014680
03454  213                RLB1                                                  00014690
03455  213                RLB1                                                  00014700
03456  213                RLB1                                                  00014710
03457  612 412            J          DECR                                       00014720
03461  077       DDIJB    DIJB       *-31                                       00014730
03462  036       CLOC     OCT        36                                         00014740
03463  036                EIB                                                   00014750
03464  010                OCT        10                                         00014760
03465  001                CBA                                                   00014770
03466  702 472            JZE        RDIJB                                      00014780
03470  164 766   HDIJB1   JST    I   $HALT                                      00014790
03472  402 461   RDIJB    LB         DDIJB                                      00014800
03474  020                LIA                                                   00014810
03475  077                OCT        77                                         00014820
03476  562 461            STA        DDIJB                                      00014830
03500  020                LIA                                                   00014840
03501  036                OCT        36                                         00014850
03502  562 462            STA        CLOC                                       00014860
03504  001                CBA                                                   00014870
03505  034                EIA                                                   00014880
03506  041                OCT        41                                         00014890
03507  702 513            JZE        TDIJB2                                     00014900
03511  164 766   HDIJB    JST    I   $HALT              DIJB FAILS              00014910
03513  003       TDIJB2   ZED                                                   00014920
03514  024                AIA                                                   00014930
03515  001                OCT        1                                          00014940
03516  042                DIJB       *-2                                        00014950
03517  777                OCT        777                                        00014960
03520  702 524            JZE        TIDX                                       00014970
03522  164 766   HDIJB2   JST    I   $HALT                                      00014980
03524  003       TIDX     ZED                                                   00014990
03525  017                IDX                                                   00015000
03526  742 532            JZED       TIDX2                                      00015010
03530  164 766            JST    I   $HALT              IDX FAILS WHEN A POSITIVE 00015020
03532  020       TIDX2    LIA                                                   00015030
03533  777                OCT        777                                        00015040
03534  022                LIB                                                   00015050
03535  777                OCT        777                                        00015060
03536  017                IDX                                                   00015070
03537  742 543            JZED       TPZC                                       00015080
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03541  164 766            JST   I    $HALT                                                  00015090
                 ***********************************************************************00015100
                 *        PAGE ZERO FLIP-FLOP TEST                                        00015110
                 ***********************************************************************00015120
03543  270       TPZC     OCI        0                  TURN ON PZC FLIP-FLOP              00015130
03544  200                 OCT        200                                                   00015140
03545  330                 INSA       0                                                     00015150
03546  206                 SLA3                                                             00015160
03547  642 553            JMI        TPZCR                                                 00015170
03551  164 766   HPZCS    JST   I    $HALT              PZC NOT ON, SHOULD HAVE BEEN       00015180
03553  270       TPZCR    OCI        0                                                     00015190
03554  100                 OCT        100                                                   00015200
03555  330                 INSA       0                                                     00015210
03556  206                 SLA3                                                             00015220
03557  652 564            JPL        TRTC               GO TEST REAL TIME CLOCK LOGIC      00015230
03561  164 766   HPZCR    JST   I    $HALT              PZC NOT RESET ,SHOULD HAVE BEEN    00015240
03563  001       ONE2     OCT        1                                                     00015250
                          EJT                                                              00015260
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                        ********************************************************************************00015270
                        *       REAL TIME CLOCK LOGIC TEST                                             00015280
                        ********************************************************************************00015290
03564  616 572  TRTC    J     I   BCDRP              SKIP REAL TIME CLOCK TEST                          00015300
03566  012              ENI                                                                            00015310
03567  010              WAIT                                                                           00015320
03570  616 572          J     I   BCDRP                                                              00015330
03572  000 052  BCDRP   DAC       SUPTST                                                             00015340
                        ********************************************************************************00015350
                        *       DISPLAY P(MSB), P(LSB), A, B, REGS                                   * 00015360
                        ********************************************************************************00015370
03574  000 000  HALT    DS        2                                                                  00015380
03576  122 616          STD       SAVAB              SAVE (AB) REGS                                  00015390
03600  172 574          LD        HALT               GET P-REG VALUE                                 00015400
03602  011              XAB                                                                          00015410
03603  224              SRD3                                                                         00015420
03604  000              HALT                         DISPLAY P-REG (MSB)                             00015430
03605  011              XAB                                                                          00015440
03606  000              HALT                         DISPLAY P-REG (LSB)                             00015450
03607  172 616          LD        SAVAB                                                              00015460
03611  000              HALT                         DISPLAY A-REG                                   00015470
03612  011              XAB                                                                          00015480
03613  000              HALT                         DISPLAY B-REG                                   00015490
03614  616 574          J     I   HALT                                                               00015500
03616  000 000  SAVAB   DS        2                                                                  00015510
                        EJT                                                                          00015520
```

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  04000                    ORG     4000B                                          00015530
                  ****************************                                    00015540
                  * I/O SIMULATOR TEST PROGRAM                                    00015550
                  ****************************                                    00015560
  04000           TEST7    EQU     *                                              00015570
 04000  000       IOINIT   HALT                  ENTER I/O CHANNEL ADDR NUMBER    00015580
 04001  007                NOOP                                                   00015590
 04002  330                INSA    0                                              00015600
 04003  370                MIA                                                    00015610
 04004  007                OCT     007                                            00015620
 04005  712 011            JNZ     IOINI2                                         00015630
 04007  612 000            J       IOINIT                                         00015640
 04011  034       IOINI2   EIA                   SET UP OCI COMMANDS              00015650
 04012  270                OCT     270                                            00015660
 04013  562 123            STA     OCI1                                           00015670
 04015  562 431            STA     OCI2                                           00015680
 04017  562 142            STA     OCI3                                           00015690
 04021  562 230            STA     CCI4                                           00015700
 04023  562 247            STA     OCI5                                           00015710
 04025  562 276            STA     OCI6                                           00015720
 04027  562 314            STA     OCI7                                           00015730
 04031  562 346            STA     OCI8                                           00015740
 04033  562 373            STA     OCI9                                           00015750
 04035  562 437            STA     OCI10                                          00015760
 04037  034                EIA                   CONVERT 27A INTO 31A OTAR        00015770
 04040  160                OCT     160                                            00015780
 04041  562 141            STA     OTAR1                                          00015790
 04043  007                NOOP                                                   00015800
 04044  007                NOOP                                                   0001581C
 04045  034                EIA                   CONVERT 31A INTO 32A INAS        00015820
 04046  030                OCT     030                                            00015830
 04047  562 144            STA     INAS1                                          00015840
 04051  562 441            STA     INAS2                                          00015850
 04053  007                NOOP                                                   00015860
 04054  007                NOOP                                                   00015870
 04055  034                EIA                   CONVERT 32A INTO 25A OIS         00015880
 04056  170                OCT     170                                            00015890
 04057  562 213            STA     OIS1                                           00015900
 04061  007                NOOP                                                   00015910
 04062  007                NOOP                                                   00015920
 04063  034                EIA                   CONVERT 25A INTO 26A BOM         00015930
 04064  030                OCT     030                                            00015940
 04065  562 233            STA     BOM1                                           00015950
 04067  562 304            STA     BOM2                                           00015960
 04071  007                NOOP                                                   00015970
 04072  034                EIA                   CONVERT 26A INTO 30A OTAS        00015980
 04073  160                OCT     160                                            00015990
 04074  562 175            STA     OTAS1                                          00016000
 04076  007                NOOP                                                   00016010
 04077  007                NOOP                                                   00016020
 04100  034                EIA                   CONVERT 30A INTO 33A INSA        00016030
 04101  030                OCT     030                                            00016040
 04102  562 125            STA     INSA1                                          00016050
 04104  007                NOOP                                                   00016060
 04105  007                NOOP                                                   00016070
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04106  034          EIA                              CONVERT 33A INTO 35A  OIR      00016080
04107  060          OCT      060                                                   00016090
04110  562 160      STA      OIR1                                                  00016100
04112  562 367      STA      OIR2                                                  00016110
04114  007          NOOP                                                           00016120
04115  034          EIA                              CONVERT 35A INTO 36A SIM      00016130
04116  030          OCT      030                                                   00016140
04117  562 252      STA      SIM1                                                  00016150
04121  562 324      STA      SIM2                                                  00016160
04123  273     OCI1 OCI      3                                                     00016170
04124  002          OCT      002                                                   00016180
04125  333     INSA1 INSA    3                                                     00016190
04126  034          EIA                                                            00016200
04127  600          OCT      600                                                   00016210
04130  702 134      JZE      TOTAR                                                 00016220
04132  164 766      JST   I  $HALT                                                 00016230
                    *                                                            00016240
                    *        ERROR HALT - OCI, INSA OR CP2 DEFECTIVE.            00016250
                    *                                                            00016260
                    *        TO TROUBLESHOOT ENTER LOCATION OCT1 INTO THE P REGISTER,  00016270
                    *        TURN THE STATIC CLOCK ON AND CLOCK TO E2T3 OF THE OCI     00016280
                    *        COMMAND. EXAMINE FOR CPC HI AND CP2 HI. NEXT CLOCK TO     00016290
                    *        E2T5 OF THE INSA INSTRUCTION AND INSURE CPS GOES HI. THEN  00016300
                    *        GO TO E2T6 AND INSURE CS GOES HI. ALSO INSURE PC08 AND PC9 00016310
                    *        ARE HI.                                             00016320
                    *                                                            00016330
04134  020     TOTAR LIA                                                         00016340
04135  760          OCT      760                                                   00016350
04136  162 427      JST      MWRITE                                                00016360
04140  007     TOTAR1 NOOP                                                       00016370
04141  313     OTAR1 OTAR    3                IF HUNG HERE NO PCR                  00016380
04142  273     OCI3 OCI      3                SELECT READ                          00016390
04143  000          OCT      000                                                   00016400
04144  323     INAS1 INAS    3                                                     00016410
04145  000          HALT                                                           00016420
04146  007          NOOP                                                           00016430
04147  034          EIA                                                            00016440
04150  777          OCT      777                                                   00016450
04151  702 155      JZE      TOIR                                                  00016460
04153  164 766      JST   I  $HALT                                                 00016470
                    *                                                            00016480
                    *        ERROR HALT - OTAR OR INAS INSTRUCTION HAS FAILED    00016490
                    *                                                            00016500
                    *        TO TROUBLESHOOT PLACE A HALT INSTRUCTION IN LOCATION TOTAR1  00016510
                    *        AND RESTART THE PROGRAM FROM LOCATION TOTAR. WHEN THE HALT   00016520
                    *        OCCURES STATIC CLOCK THE CPU TO F1T3 AND INSURE CPI AND CPIO 00016530
                    *        ARE BOTH HI. CLOCK TO E2T6 AND INSURE CS,CP5,CP6,CP7,CP8 AND 00016540
                    *        CP9 ARE ALL HI. CONTINUE CLOCKING TO F1T3 OF THE INAS        00016550
                    *        INSTRUCTION AND INSURE CPO AND CPIO ARE BOTH HI. CONTINUE    00016560
                    *        TO E2T6 AND CHECK FOR CS AND ALL PC01 TO PC09 SIGNALS HI.    00016570
                    *                                                            00016580
04155  162 427 TOIR JST      MWRITE                                                00016590
04157  007     TOIR1 NOOP                                                        00016600
04160  353     OIR1 OIR      3                                                   00016610
04161  017          OCT      017                                                   00016620
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04162  162 435          JST        MREAD                                  00016630
04164  702 170          JZE        TOTAS                                  00016640
04166  164 766          JST   I    $HALT                                  00016650
                *       ERROR HALT - OIR INSTRUCTION DEFECTIVE.          00016660
                *                                                        00016670
                *       TO TROUBLESHOOT PLACE A HALT INSTRUCTION IN LOCATION TOIR1 00016680
                *       AND RESTART THE PROGRAM FROM LOCATION TOIR. WHEN THE 00016690
                *       HALT OCCURES GO TO STATIC CLOCK MODE AND CLOCK TO OIR F1T3 00016700
                *       AND INSURE CP0 AND CP10 ARE BOTH HI. CONTINUE CLOCKING TO 00016710
                *       E1T3 AND INSURE CS IS HI AND THE BIT PATTERN ON THE CP LINES 00016720
                *       IS 017.                                          00016730
                *                                                        0001674C
04170  162 427  TOTAS    JST        MWRITE                                 00016750
04172  020              LIA                                               00016760
04173  777              OCT        777                                    00016770
04174  007       TOTAS1 NOOP                                              00016780
04175  303       OTAS1  OTAS       3                                      00016790
04176  000              HALT                          SEE NOTE BELOW      00016800
04177  007              NOOP                                              00016810
04200  162 435          JST        MREAD                                  00016820
04202  034              EIA                                               00016830
04203  760              OCT        760                                    00016840
04204  702 210          JZE        TOIS                                   00016850
04206  164 766          JST   I    $HALT                                  00016860
                *                                                        00016870
                *       ERROR HALT - OTAS INSTRUCTION IS DEFECTIVE.      00016880
                *                                                        00016890
                *       TO TROUBLESHOOT PLACE A HALT INSTRUCTION IN LOCATION TOTAS1 00016900
                *       AND RESTART FROM LOCATION TOTAS. WHEN THE CPU HALTS PLACE 00016910
                *       THE CPU IN A STATIC CLOCK MODE AND CLOCK TO F1T3 OF THE OTAS 00016920
                *       INSTRUCTION. EXAMINE CP0 AND CP10 TO INSURE THEY ARE BOTH 00016930
                *       HI. CONTINUE CLOCKING TO E2T6 AND CHECK CS.  DATA ON THE CP 00016940
                *       LINES SHOULD BE ALL HI.                          00016950
                *                                                        00016960
04210  162 427  TOIS     JST        MWRITE                                 00016970
04212  007       TOIS1  NOOP                                              00016980
04213  253       OIS1   OIS        3                                      00016990
04214  000              OCT        000                                    00017000
04215  000              HALT                                              00017010
04216  007              NOOP                                              00017020
04217  162 435          JST        MREAD                                  00017030
04221  034              EIA                                               00017040
04222  017              OCT        017                                    00017050
04223  702 227          JZE        TBOM                                   00017060
04225  164 766          JST   I    $HALT                                  00017070
                *                                                        00017080
                *       ERROR HALT - OIS INSTRUCTION DEFECTIVE.          00017090
                *                                                        00017100
                *       TO TROUBLESHOOT PLACE A HALT INSTRUCTION IN LOCATION TOIS1 00017110
                *       AND RESTART FROM TOIS. WHEN THE HALT OCCURES, PLACE THE CPU 00017120
                *       IN THE STATIC CLOCK MODE AND CLOCK TO F1T3 OF THE OIS 00017130
                *       INSTRUCTION. EXAMINE CP0 AND CP10 TO INSURE THEY ARE BOTH 00017140
                *       HI. CONTINUE CLOCKING TO E2T3 AND INSURE CS IS HI AND THE 00017150
                *       CORRECT BIT PATTERN IS ON THE LINE.              00017160
                *                                                        00017170
```

```
                *
04227  007      TBOM     NOOP
04230  273      OCI4     OCI        3
04231  006               OCT        006
04232  003               ZED
04233  263      BOM1     BOM        3
04234  440 042           DAC        BOMBUF
04236  036               EIB
04237  001               OCT        001
04240  742 246           JZED       TSIM
04242  164 766           JST   I    $HALT
                *
                *        ERROR HALT - BOM INSTRUCTION FAILED.
                *
                *        TO TROUBLESHOOT STEP THRU THE MICRO PROGRAM OF THE BOM
                *        INSTRUCTION. PCE SHOULD TERMINATE
                *
04244  777      BOMBUF   OCT        777
04245  777               OCT        777
04246  007      TSIM     NOOP
04247  273      OCI5     OCI        3
04250  004               OCT        004
04251  003               ZED
04252  363      SIM1     SIM        3
04253  630 042           DAC        SIMBUF
04255  036               EIB
04256  001               OCT        001
04257  742 265           JZED       TSIM1
04261  164 766           JST   I    $HALT
                *
                *        ERROR HALT - SIM INSTRUCTION FAILED.
                *
                *        TO TROUBLESHOOT USE THE MICRO PROGRAM AND STATIC CLOCK
                *        THRU THE SIM INSTRUCTION.
                *
04263  000      SIMBUF   OCT        0
04264  000               OCT        0
04265  172 263  TSIM1    LD         SIMBUF
04267  034               EIA
04270  760               OCT        760
04271  742 275           JZED       TBOM2
04273  164 766           JST   I    $HALT
                *
                *        ERROR HALT - SIM OR BOM ERROR.
                *
04275  007      TBOM2    NOOP
04276  273      OCI6     OCI        3
04277  006               OCT        006
04300  003               ZED
04301  022               LIB
04302  001               OCT        001
04303  014               COMD
04304  263      BOM2     BOM        3
04305  440 042           DAC        BOMBUF
04307  742 313           JZED       TSIM2
```

```
04311  164 766          JST   I    $HALT
                *
                *       ERROR HALT - BOM WITH OVERFLOW TERMINATION FAILED. STATIC
                *       CLOCK THRU THE BOM MICRO
                *
04313  007      TSIM2   NOOP
04314  273      OCI7    OCI        3
04315  004              OCT        004                  SELECT SIM OPERATION
04316  003              ZED
04317  122 263          STD        SIMBUF
04321  022              LIB
04322  001              OCT        001
04323  014              COMD
04324  363      SIM2    SIM        3
04325  630 042          DAC        SIMBUF
04327  172 263          LD         SIMBUF
04331  034              EIA
04332  760              OCT        760
04333  742 337          JZED       TDMCW
04335  164 766          JST   I    $HALT
                *
                *       ERROR HALT - SIM INSTRUCTION FAILED. ONE WORD SHOULD HAVE
                *       BEEN TRANSFERED AND TERMINATION BY OVERFLOW.
                *
                *
04337  003      TDMCW   ZED
04340  122 452          STD        DMCBUF
04342  416 446          LDMC  I    DMCCOUNT
04344  416 450          LDMC  I    DMCPOINT
04346  273      OCI8    OCI        3                    SELECT DMC WRITE
04347  003              OCT        003
04350  162 435          JST        MREAD                GO READ DMC
04352  034              EIA
04353  017              OCT        017
04354  702 360          JZE        TDMCR
04356  164 766          JST   I    $HALT
                *
                *       ERROR HALT - DMC WRITE FAILED
                *
04360  007      TDMCR   NOOP
04361  416 446          LDMC  I    DMCCOUNT
04363  416 450          LDMC  I    DMCPOINT
04365  162 427          JST        MWRITE               SELECT SIMULATOR WRITE MODE
04367  353      OIR2    OIR        3                    OUTPUT ALL HIGHS
04370  777              OCT        777
04371  472 452          STZ        DMCBUF
04373  273      OCI9    OCI        3                    SELECT DMC READ
04374  001              OCT        001
04375  007              NOOP
04376  007              NOOP
04377  007              NOOP
04400  013              CDMC
04401  011              XAB
04402  112 454          SUD        CKADD
04404  742 410          JZED       TDMCR1
```

```
04406  164 766            JST    I     $HALT                                                  00018280
                  *                                                                          00018290
                  *        ERROR HALT - ONLY ONE WORD SHOULD HAVE BEEN READ BY DMC           00018300
                  *        READ OPERATION.                                                   00018310
                  *                                                                          00018320
04410  172 452   TDMCR1    LD           DMCBUF                                                00018330
04412  034                 EIA                                                                00018340
04413  760                 OCT          760                                                   00018350
04414  742 420             JZED         IOTEND                                                00018360
                  *                                                                          00018370
04416  164 766             JST    I     $HALT                                                  00018380
                  *        ERROR HALT - DURING DMC READ ONLY ONE WORD SHOULD HAVE BEEN       00018390
                  *        TRANSFERED (IF B NE.ZERO)                                         00018400
                  *                                                                          00018410
04420  007       IOTEND    NOOP                                                               00018420
04421  020                 LIA                                                                00018430
04422  777                 OCT          777                                                   00018440
04423  164 766             JST    I     $HALT                 END OF I/O TEST                 00018450
04425  614 764             J      I     STESTP                                                00018460
                  *                                                                          00018470
04427  000 000   MWRITE    OCTD         0                                                     00018480
04431  273       OCI2      OCI          3                     SELECT OUTPUT OPERATION         00018490
04432  002                 OCT          002                                                   00018500
04433  616 427             J      I     MWRITE                                                00018510
04435  000 000   MREAD     OCTD         0                                                     00018520
04437  273       OCI10     OCI          3                     SELECT READ OPERATION           00018530
04440  000                 OCT          000                                                   00018540
04441  323       INAS2     INAS         3                     READ                            00018550
04442  000                 HALT                                                               00018560
04443  007                 NOOP                                                               00018570
04444  616 435             J      I     MREAD                                                 00018580
04446  770 777   DMCCOUNT  OCTD         770777                                                00018590
04450  510 044   DMCPOINT  DAC          DMCBUF-1                                              00018600
04452  000 000   DMCBUF    OCTD         0                                                     00018610
04454  520 044   CKADD     DAC          DMCBUF                                                00018620
                           EJT                                                                00018630
```

```
 05000                       ORG        5000B
                    *****************************************************************
                    *        BCD COUNTING ROUTINE
                    *****************************************************************
05000  172 150  BCDR     LD         NUM
05002  102 152           ADD        ONES1
05004  122 150           STD        NUM
05006  001      KLSDB    CBA                              TRANSFER LSD, AND 2SD TO A REG
05007  370               MIA                              GET LSD BCD DIGIT
05010  017               OCT        17
05011  024               AIA                              CHECK IF GREATER THAN 9, IF SO
05012  366               OCT        366                   ADD THE CARRY TO 2SD, IF NOT
05013  642 100           JMI        KLSD                  RESTORE THE ORIGINAL DIGIT AND
05015  024               AIA                              OUTPUT TO DISPLAY
05016  412               OCT        412                   8,SCOMPLEMENT OF 366
05017  310               OTAR       0                     OUTPUT LSD
05020  172 150           LD         NUM
05022  001      K2SDB    CBA
05023  205               SRA3                             LINE-UP 2SD BCD DIGIT
05024  201               SRA1
05025  370               MIA
05026  017               OCT        17
05027  024               AIA
05030  366               OCT        366
05031  642 110           JMI        K2SD
05033  024               AIA
05034  412               OCT        412
05035  310               OTAR       0                     OUTPUT 2SD
05036  172 150           LD         NUM
05040  222      K3SDB    SLD1                             LINE-UP 3SD
05041  370               MIA
05042  017               OCT        17
05043  024               AIA
05044  366               OCT        366
05045  642 120           JMI        K3SD
05047  024               AIA
05050  412               OCT        412
05051  310               OTAR       0                     OUTPUT 3SD
05052  172 150           LD         NUM
05054  205      K4SDB    SRA3                             LINE-UP 4SD
05055  370               MIA
05056  017               OCT        17
05057  024               AIA
05060  366               OCT        366
05061  642 130           JMI        K4SD
05063  024               AIA
05064  412               OCT        412
05065  310               OTAR       0                     OUTPUT 4SD
05066  040               DIJB       *
05067  777               OCT        777
05070  042               DIJB       *-2
05071  000      HOLD1    OCT        0
05072  020               LIA
05073  000               OCT        0
05074  562 071           STA        HOLD1
```

```
05076  614 764            J     I    STESTP                                  00019190
05100  172 150  KLSD      LD         NUM                                     00019200
05102  102 140            ADD        ADDD                                    00019210
05104  122 150            STD        NUM                                     00019220
05106  612 006            J          KLSDB                                   00019230
05110  172 150  K2SD      LD         NUM                                     00019240
05112  102 142            ADD        ADDD+2                                  00019250
05114  122 150            STD        NUM                                     00019260
05116  612 022            J          K2SDB                                   00019270
05120  172 150  K3SD      LD         NUM                                     00019280
05122  102 144            ADD        ADDD+4                                  00019290
05124  122 150            STD        NUM                                     00019300
05126  612 040            J          K3SDB                                   00019310
05130  172 150  K4SD      LD         NUM                                     00019320
05132  102 146            ADD        ADDD+6                                  00019330
05134  122 150            STD        NUM                                     00019340
05136  612 054            J          K4SDB                                   00019350
05140  000 006  ADDD      OCTD       6                                       00019360
05142  000 140            OCTD       140                                     00019370
05144  003 000            OCTD       3000                                    00019380
05146  060 000            OCTD       60000                                   00019390
05150  000 000  NUM       OCTD       0                                       00019400
05152  000 001  ONES1     OCTD       1                                       00019410
                          EJT                                                00019420
```

```
                  ***********************************************************************
                  *        TEST6
                  ***********************************************************************
05154  270        TEST6    OCI        0                  ARM MANUAL INTERRUPT
05155  002                 OCT        2
05156  012                 ENI
05157  010                 WAIT
05160  164 766             JST   I    $HALT              HALT HERE AFTER MAN INT TEST
05162  614 764             J     I    STESTP
  05200                    ORG        5200B
05200  172 461    SUPTST   LD         DJADDR
05202  122 463             STD        DJPNTR
05204  606 463             DJ    I    DJPNTR             TEST DJ INDIRECT
05206  172 463             LD         DJPNTR
05210  034                 EIA
05211  001                 OCT        1
05212  036                 EIB
05213  001                 OCT        1
05214  742 220             JZED       RESTOR
05216  164 766             JST   I    $HALT              DJI ERROR
                  *
05220  172 461    RESTOR   LD         DJADDR             RESTORES DJ ADDRESS
05222  122 463             STD        DJPNTR
05224  612 226             J          AMAG
                  *
                  *
                  *
05226  020        AMAG     LIA                           TEST AMAG A9=0
05227  252                 OCT        252
05230  022                 LIB
05231  525                 OCT        525
05232  142 455             AMAG       AMAGB1
05234  034                 EIA
05235  525                 OCT        525
05236  036                 EIB
05237  252                 OCT        252
05240  742 244             JZED       AMAGM
05242  164 766             JST   I    $HALT              AMAG ERROR
                  *
                  *
                  *
05244  612 263    AMAGM    J          ARS1A              TEST AMAG A9=1
05246  400                 OCT        400
05247  022                 LIB
05250  000                 OCT        0
05251  142 457             AMAG       AMAGB2
05253  034                 EIA
05254  400                 OCT        400
05255  036                 EIB
05256  000                 OCT        0
05257  742 263             JZED       ARS1A
05261  164 766             JST   I    $HALT              AMAG ERROR
                  *
                  *
                  *
```

```
05263  020        ARS1A    LIA                        TEST ARS1 A9=0          00019980
05264  252                 OCT       252                                      00019990
05265  022                 LIB                                                00020000
05266  525                 OCT       525                                      00020010
05267  221                 ARS1                                               00020020
05270  034                 EIA                                                00020030
05271  125                 OCT       125                                      00020040
05272  036                 EIB                                                00020050
05273  252                 OCT       252                                      00020060
05274  742 300             JZED      ARS1B                                    00020070
05276  164 766             JST   I   $HALT              ARS1 ERROR             00020080
                   *                                                          00020090
05300  020        ARS1B    LIA                        TEST ARS1  A9=1         00020100
05301  525                 OCT       525                                      00020110
05302  022                 LIB                                                00020120
05303  252                 OCT       252                                      00020130
05304  221                 ARS1                                               00020140
05305  034                 EIA                                                00020150
05306  652                 OCT       652                                      00020160
05307  036                 EIB                                                00020170
05310  525                 OCT       525                                      00020180
05311  742 315             JZED      ARS3A                                    00020190
05313  164 766             JST   I   $HALT              ARS1 ERROR             00020200
                   *                                                          00020210
                   *                                                          00020220
                   *                                                          00020230
05315  020        ARS3A    LIA                        TEST ARS3 A9=0          00020240
05316  252                 OCT       252                                      00020250
05317  022                 LIB                                                00020260
05320  525                 OCT       525                                      00020270
05321  225                 ARS3                                               00020280
05322  034                 EIA                                                00020290
05323  025                 OCT       025                                      00020300
05324  036                 EIB                                                00020310
05325  252                 OCT       252                                      00020320
05326  742 332             JZED      ARS3B                                    00020330
05330  164 766             JST   I   $HALT              ARS3 ERROR             00020340
                   *                                                          00020350
05332  020        ARS3B    LIA                        TEST ARS3 A9=1          00020360
05333  525                 OCT       525                                      00020370
05334  022                 LIB                                                00020380
05335  252                 OCT       252                                      00020390
05336  225                 ARS3                                               0002040C
05337  034                 EIA                                                00020410
05340  752                 OCT       752                                      00020420
05341  036                 EIB                                                00020430
05342  525                 OCT       525                                      00020440
05343  742 347             JZED      SMAG                                     00020450
05345  164 766             JST   I   $HALT              ARS3 ERROR             00020460
                   *                                                          00020470
                   *                                                          00020480
                   *                                                          00020490
05347  020        SMAG     LIA                        TEST SMAG A9=0          00020500
05350  000                 OCT       0                                        00020510
05351  022                 LIB                                                00020520
```

```
05352  001          OCT     1                                          00020530
05353  122 453      STD     SPNTR                                      00020540
05355  003          ZED                                                00020550
05356  152 453      SMAG    SPNTR                                      00020560
05360  034          EIA                                                00020570
05361  777          OCT     777                                        00020580
05362  036          EIB                                                00020590
05363  777          OCT     777                                        00020600
05364  742 370      JZED    SMAGA                                      00020610
05366  164 766      JST  I  $HALT           SMAG ERROR                 00020620
                    *                                                  00020630
                    *                                                  00020640
05370  020      SMAGA  LIA                     TEST SMAG A9=1          00020650
05371  400          OCT     400                                        00020660
05372  022          LIB                                                00020670
05373  000          OCT     0                                          00020680
05374  122 451      STD     SPNTRA                                     00020690
05376  020          LIA                                                00020700
05377  377          OCT     377                                        00020710
05400  022          LIB                                                00020720
05401  777          OCT     777                                        00020730
05402  152 451      SMAG    SPNTRA                                     00020740
05404  034          EIA                                                00020750
05405  777          OCT     777                                        00020760
05406  036          EIB                                                00020770
05407  777          OCT     777                                        00020780
05410  742 427      JZED    JMIA                                       00020790
05412  164 766      JST  I  $HALT           SMAG ERROR                 00020800
                    *                                                  00020810
                    *                                                  00020820
                    *                                                  00020830
05414  020      TST7SP LIA                     TEST #7 SUPPLEMENT      00020840
05415  777          OCT     777                                        00020850
05416  240          OIS   X CPU                                        00020860
05417  001          OCT     001                                        00020870
05420  007          OCT     007                                        00020880
05421  164 766      JST  I  $HALT                                      00020890
05423  616 425      J    I  STESTA                                     00020900
05425  420 076  STESTA DAC     STEST                                  00020910
                    *                                                  00020920
                    *                                                  00020930
                    *                                                  00020940
05427  020      JMIA   LIA                     TEST JMI INDIRECT A9=1  00020950
05430  400          OCT     400                                        00020960
05431  646 447      JMI  I  JMIB                                       00020970
05433  164 766      JST  I  $HALT           JMI ERROR                  00020980
                    *                                                  00020990
05435  020      JMIC   LIA                     TEST JMI INDIRECT A9=0  0002100C
05436  000          OCT     0                                          00021010
05437  646 447      JMI  I  JMIB                                       00021020
05441  632 000      JNOV    BCDR                                       00021030
05443  164 766      JST  I  $HALT           JMI ERROR                  00021040
05445  612 000      J       BCDR                                       00021050
                    ********************************************************00021060
05447  350 054  JMIB   DAC     JMIC                                   00021070
```

```
05451  000 000  SPNTRA   DS      2                                  00021080
05453  000 000  SPNTR    DS      2                                  00021090
05455  525 253  AMAGB1   OCTD    525253                             00021100
05457  525 253  AMAGB2   OCTD    525253                             00021110
05461  771 000  DJADDR   OCTD    771000                             00021120
05463  000 000  DJPNTR   DS      2                                  00021130
                        EJT                                        00021140
```

```
  06772                    ORG        6772B                                    00021150
06772  616 776  GOBAK      J     I    MNRET                                    00021160
06774  612 772  P3START    J          GOBAK                                    00021170
06776  340 000  MNRET      DAC        TJ                                       00021180
                           EJT                                                 00021190
```

```
                    ********************************************************************************00021200
                    *       TESTO                                                                  00021210
                    ********************************************************************************00021220
07000  330          TESTO   INSA    0                                                              00021230
07001  310                  OTAR    0                                                              00021240
07002  270                  OCI     0               READ DATA ENTRY SW                             00021250
07003  010                  OCT     010                                                            00021260
07004  320                  INAS    0                                                              00021270
07005  612 004              J       *-1                                                            00021280
07007  370                  MIA                                                                    00021290
07010  007                  OCT     7               SAVE 1ST DIGIT ONLY                            00021300
07011  702 000              JZE     TESTO           STAY ON TESTO                                  00021310
07013  612 642              J       STEST           GO TO ANOTHER TEST                             00021320
  07034                      ORG     70348                                                          00021330
                    ********************************************************************************00021340
                    *       TEST2                                                                  00021350
                    ********************************************************************************00021360
07034  442 051      TEST2   LA      SUM                                                            00021370
07036  310                  OTAR    0                                                              00021380
07037  041                  DIJB    *-1                                                            00021390
07040  777                  OCT     777             SEVEN SEGMENT DECODER/DRIVERS                  00021400
07041  043                  DIJB    *-3                                                            00021410
07042  777                  OCT     777                                                            00021420
07043  024                  AIA                                                                    00021430
07044  001                  OCT     1                                                              00021440
07045  562 051              STA     SUM                                                            00021450
07047  612 642              J       STEST                                                          00021460
07051  000          SUM     OCT     0                                                              00021470
                            EJT                                                                    00021480
```

```
                ********************************************************************************00021490
                *       TEST3                                                                  00021500
                ********************************************************************************00021510
07052  320      TEST3   INAS    0               SET SCAN F/F AND READ LSD AND                  00021520
07053  612 052          J       *-1             2SD SWITCHES                                   00021530
07055  011              XAB                     SAVE LSD AND 2SD IN B REGISTER                 00021540
07056  270              OCI     0               RESET SCAN F/F                                 00021550
07057  010              OCT     10                                                             00021560
07060  320              INAS    0               READ 3SD AND MSD SWITCHES                      00021570
07061  612 060          J       *-1                                                            00021580
07063  310              OTAR    0               OUTPUT  MSD                                    00021590
07064  234              RRD3                                                                   00021600
07065  230              RRD1                                                                   00021610
07066  310              OTAR    0               OUTPUT  3SD                                    00021620
07067  230              RRD1                    GET RID OF 9TH BIT                             00021630
07070  234              RRD3                                                                   00021640
07071  230              RRD1                                                                   00021650
07072  310              OTAR    0               OUTPUT  2SD                                    00021660
07073  234              RRD3                                                                   00021670
07074  230              RRD1                                                                   00021680
07075  310              OTAR    0               OUTPUT  LSD                                    00021690
07076  040              DIJB    *                                                              00021700
07077  777              OCT     777             HOLD DISPLAY                                   00021710
07100  042              DIJB    *-2                                                            00021720
07101  040      HOLD    OCT     40                                                             00021730
07102  350              OIR     0               OUTPUT BLANK CODE                              00021740
07103  017              OCT     17                                                             00021750
07104  042              DIJB    *-2             HOLD BLANKOUT                                  00021760
07105  777              OCT     777                                                            00021770
07106  042              DIJB    *-2                                                            00021780
07107  040      BLANK   OCT     40                                                             00021790
07110  020              LIA                                                                    00021800
07111  040              OCT     40                                                             00021810
07112  562 101          STA     HOLD                                                           00021820
07114  562 107          STA     BLANK                                                          00021830
07116  612 642          J       STEST           READ TEST SWITCH POSITION                      00021840
                        EJT                                                                    00021850
```

```
                        ********************************************************************************00021860
                        *       TEST4                                                                  00021870
                        ********************************************************************************00021880
07120  172 166  TEST4   LD      NUMBER          GET AN 18 BIT NUMBER IN AB      00021890
07122  102 170          ADD     ONES            ADD 1 TO IT                     00021900
07124  122 166          STD     NUMBER          SAVE FOR DISPLAY                00021910
07126  011              XAB                                                     00021920
07127  370              MIA                                                     0002193C
07130  007              OCT     7                                               00021940
07131  310              OTAR    0               DISPLAY LSD  OCTAL DIGIT        00021950
07132  172 166          LD      NUMBER                                          00021960
07134  011              XAB                                                     00021970
07135  234              RRD3                    GET READY 2SD OCTAL DIGIT       00021980
07136  370              MIA                                                     00021990
07137  007              OCT     7                                               00022000
07140  310              OTAR    0               DISPLAY 2SD OCTAL DIGIT         00022010
07141  172 166          LD      NUMBER                                          00022020
07143  226              SLD3                    GET 3SD OCTAL DIGIT FROM B      00022030
07144  370              MIA                                                     00022040
07145  007              OCT     7                                               00022050
07146  310              OTAR    0               DISPLAY 3SD OCTAL DIGIT         00022060
07147  172 166          LD      NUMBER                                          00022070
07151  370              MIA                                                     00022080
07152  007              OCT     7                                               00022090
07153  310              OTAR    0               DISPLAY MSD OCTAL DIGIT         00022100
07154  040              DIJB    *               HOLD DISPLAY                    00022110
07155  777              OCT     777                                             00022120
07156  042              DIJB    *-2                                             00022130
07157  040      KNT     OCT     40                                              00022140
07160  020              LIA                     ESTABLISH  DISPLAY PERIOD       00022150
07161  004              OCT     4                                               00022160
07162  562 157          STA     KNT                                             00022170
07164  612 642          J       STEST           READ SWITCH POSITION            00022180
07166  000 000  NUMBER  DAC     0                                               00022190
07170  000 001  ONES    OCTD    000001                                          00022200
                        EJT                                                     00022210
```

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                        ********************************************************************************00022220
                        *       TEST5                                                                  00022230
                        ********************************************************************************00022240
07172  172 556  TEST5   LD        PNTR1                                                                 00022250
07174  122 576          STD       PNTR11                                                                00022260
07176  022              LIB                                                                             00022270
07177  007              OCT       7                                                                     00022280
07200  522 227          STB       DIJB1                                                                 00022290
07202  020              LIA                                                                             00022300
07203  001              OCT       1                                                                     00022310
07204  562 616          STA       AUG                                                                   00022320
07206  020      LOOP11  LIA                                                                             00022330
07207  001              OCT       1                                                                     00022340
07210  542 616          ADA       AUG                                                                   00022350
07212  556 576          SUA   I   PNTR11                                                                00022360
07214  712 617          JNZ       FAIL1                                                                 00022370
07216  432 616          RLM1      AUG                                                                   00022380
07220  402 616          LB        AUG                                                                   00022390
07222  036              EIB                                                                             00022400
07223  001              OCT       1                                                                     00022410
07224  522 616          STB       AUG                                                                   00022420
07226  060              DIJB      LOOP11                                                                00022430
07227  007      DIJB1   OCT       7                                                                     00022440
07230  020              LIA                                                                             00022450
07231  001              OCT       1                                                                     00022460
07232  024              AIA                                                                             00022470
07233  777              OCT       777                                                                   00022480
07234  712 617          JNZ       FAIL1                                                                 00022490
                        *                                                                               00022500
                        *                                                                               00022510
07236  172 560          LD        PNTR2                                                                 00022520
07240  122 600          STD       PNTR22                                                                00022530
07242  022              LIB                                                                             00022540
07243  006              OCT       6                                                                     00022550
07244  522 273          STB       DIJB2                                                                 00022560
07246  020              LIA                                                                             00022570
07247  002              OCT       2                                                                     00022580
07250  562 616          STA       AUG                                                                   00022590
07252  020      LOOP22  LIA                                                                             00022600
07253  002              OCT       2                                                                     00022610
07254  542 616          ADA       AUG                                                                   00022620
07256  556 600          SUA   I   PNTR22                                                                00022630
07260  712 621          JNZ       FAIL2                                                                 00022640
07262  432 616          RLM1      AUG                                                                   00022650
07264  402 616          LB        AUG                                                                   00022660
07266  036              EIB                                                                             00022670
07267  002              OCT       2                                                                     00022680
07270  522 616          STB       AUG                                                                   00022690
07272  060              DIJB      LOOP22                                                                00022700
07273  007      DIJB2   OCT       7                                                                     00022710
                        *                                                                               00022720
                        *                                                                               00022730
07274  172 562          LD        PNTR3                                                                 00022740
07276  122 602          STD       PNTR33                                                                00022750
07300  022              LIB                                                                             00022760
```

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07301  005                 OCT        5                                  00022770
07302  522 331             STB        DIJB3                              00022780
07304  020                 LIA                                           00022790
07305  004                 OCT        4                                  00022800
07306  562 616             STA        AUG                                00022810
07310  020        LOOP3    LIA                                           00022820
07311  004                 OCT        4                                  00022830
07312  542 616             ADA        AUG                                00022840
07314  556 602             SUA    I   PNTR33                             00022850
07316  712 623             JNZ        FAIL3                              00022860
07320  432 616             RLM1       AUG                                00022870
07322  402 616             LB         AUG                                00022880
07324  036                 EIB                                           00022890
07325  004                 OCT        4                                  00022900
07326  522 616             STB        AUG                                00022910
07330  060                 DIJB       LOOP3                              00022920
07331  006        DIJB3    OCT        6                                  00022930
                  *                                                      00022940
                  *                                                      00022950
07332  172 564             LD         PNTR4                              00022960
07334  122 604             STD        PNTR44                             00022970
07336  022                 LIB                                           00022980
07337  004                 OCT        4                                  00022990
07340  522 367             STB        DIJB4                              00023000
07342  020                 LIA                                           00023010
07343  010                 OCT        10                                 00023020
07344  562 616             STA        AUG                                00023030
07346  020        LOOP4    LIA                                           00023040
07347  010                 OCT        10                                 00023050
07350  542 616             ADA        AUG                                00023060
07352  556 604             SUA    I   PNTR44                             00023070
07354  712 625             JNZ        FAIL4                              00023080
07356  432 616             RLM1       AUG                                00023090
07360  402 616             LB         AUG                                00023100
07362  036                 EIB                                           00023110
07363  010                 OCT        10                                 00023120
07364  522 616             STB        AUG                                00023130
07366  060                 DIJB       LOOP4                              00023140
07367  005        DIJB4    OCT        5                                  00023150
                  *                                                      00023160
                  *                                                      00023170
07370  172 566             LD         PNTR5                              00023180
07372  122 606             STD        PNTR55                             00023190
07374  022                 LIB                                           00023200
07375  003                 OCT        3                                  00023210
07376  522 425             STB        DIJB5                              00023220
07400  020                 LIA                                           00023230
07401  020                 OCT        20                                 00023240
07402  562 616             STA        AUG                                00023250
07404  020        LOOP5    LIA                                           00023260
07405  020                 OCT        20                                 00023270
07406  542 616             ADA        AUG                                00023280
07410  556 606             SUA    I   PNTR55                             00023290
07412  712 627             JNZ        FAIL5                              00023300
07414  432 616             RLM1       AUG                                00023310
```

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07416  402 616          LB        AUG                              00023320
07420  036              EIB                                        00023330
07421  020              OCT       20                               00023340
07422  522 616          STB       AUG                              00023350
07424  060              DIJB      LOOP5                            00023360
07425  004       DIJB5  OCT       4                                00023370
                 *                                                 00023380
                 *                                                 00023390
07426  172 570          LD        PNTR6                            00023400
07430  122 610          STD       PNTR66                           00023410
07432  022              LIB                                        00023420
07433  002              OCT       2                                00023430
07434  522 463          STB       DIJB6                            00023440
07436  020              LIA                                        00023450
07437  040              OCT       40                               00023460
07440  562 616          STA       AUG                              00023470
07442  020       LOOP6  LIA                                        00023480
07443  040              OCT       40                               00023490
07444  542 616          ADA       AUG                              00023500
07446  556 610          SUA   I   PNTR66                          00023510
07450  712 631          JNZ       FAIL6                            00023520
07452  432 616          RLM1      AUG                              00023530
07454  402 616          LB        AUG                              00023540
07456  036              EIB                                        00023550
07457  040              OCT       40                               00023560
07460  522 616          STB       AUG                              00023570
07462  060              DIJB      LOOP6                            00023580
07463  003       DIJB6  OCT       3                                00023590
                 *                                                 00023600
                 *                                                 00023610
07464  172 572          LD        PNTR7                            00023620
07466  122 612          STD       PNTR77                           00023630
07470  022              LIB                                        00023640
07471  001              OCT       1                                00023650
07472  522 521          STB       DIJB7                            00023660
07474  020              LIA                                        00023670
07475  100              OCT       100                              00023680
07476  562 616          STA       AUG                              00023690
07500  020       LOOP7  LIA                                        00023700
07501  100              OCT       100                              00023710
07502  542 616          ADA       AUG                              00023720
07504  556 612          SUA   I   PNTR77                          00023730
07506  712 633          JNZ       FAIL7                            00023740
07510  432 616          RLM1      AUG                              00023750
07512  402 616          LB        AUG                              00023760
07514  036              EIB                                        00023770
07515  100              OCT       100                              00023780
07516  522 616          STB       AUG                              00023790
07520  060              DIJB      LOOP7                            00023800
07521  002       DIJB7  OCT       2                                00023810
                 *                                                 00023820
                 *                                                 00023830
07522  020              LIA                                        00023840
07523  200              OCT       200                              00023850
07524  562 616          STA       AUG                              00023860
```

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07526  020              LIA                                          00023870
07527  200              OCT      200                                 00023880
07530  542 616          ADA      AUG                                 00023890
07532  552 555          SUA      TAB8                                00023900
07534  712 635          JNZ      FAIL8                               00023910
                *                                                    00023920
                *                                                    00023930
07536  020              LIA                                          00023940
07537  400              OCT      400                                 00023950
07540  024              AIA                                          00023960
07541  400              OCT      400                                 00023970
07542  712 637          JNZ      FAIL9                               00023980
07544  612 642          J        STEST                               00023990
                        EJT                                          00024000
```

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07546  002       TAB1     OCT        2                                    00024010
07547  004       TAB2     OCT        4                                    00024020
07550  010       TAB3     OCT        10                                   00024030
07551  020       TAB4     OCT        20                                   00024040
07552  040       TAB5     OCT        40                                   00024050
07553  100       TAB6     OCT        100                                  00024060
07554  200       TAB7     OCT        200                                  00024070
07555  400       TAB8     OCT        400                                  00024080
07556  451 075   PNTR1    DAC    1   TAB1-1                                00024090
07560  461 075   PNTR2    DAC    1   TAB2-1                                00024100
07562  471 075   PNTR3    DAC    1   TAB3-1                                00024110
07564  501 075   PNTR4    DAC    1   TAB4-1                                00024120
07566  511 075   PNTR5    DAC    1   TAB5-1                                00024130
07570  521 075   PNTR6    DAC    1   TAB6-1                                00024140
07572  531 075   PNTR7    DAC    1   TAB7-1                                00024150
07574  541 075   PNTR8    DAC    1   TAB8-1                                00024160
07576  451 075   PNTR11   DAC    1   TAB1-1                                00024170
07600  461 075   PNTR22   DAC    1   TAB2-1                                00024180
07602  471 075   PNTR33   DAC    1   TAB3-1                                00024190
07604  501 075   PNTR44   DAC    1   TAB4-1                                00024200
07606  511 075   PNTR55   DAC    1   TAB5-1                                00024210
07610  521 075   PNTR66   DAC    1   TAB6-1                                00024220
07612  531 075   PNTR77   DAC    1   TAB7-1                                00024230
07614  541 075   PNTR88   DAC    1   TAB8-1                                00024240
07616  001       AUG      OCT        1                                    00024250
07617  164 766   FAIL1    JST    I   $HALT                                 00024260
07621  164 766   FAIL2    JST    I   $HALT                                 00024270
07623  164 766   FAIL3    JST    I   $HALT                                 00024280
07625  164 766   FAIL4    JST    I   $HALT                                 00024290
07627  164 766   FAIL5    JST    I   $HALT                                 00024300
07631  164 766   FAIL6    JST    I   $HALT                                 00024310
07633  164 766   FAIL7    JST    I   $HALT                                 00024320
07635  164 766   FAIL8    JST    I   $HALT                                 00024330
07637  164 766   FAIL9    JST    I   $HALT                                 00024340
07641  000               HALT                                             00024350
                 ***********************************************************00024360
                         EJT                                              00024370
```

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                  *       ******************************                                  00024380
                  *       *DETERMINATION OF TEST NUMBER*                                  00024390
                  *       ******************************                                  00024400
07642  330        STEST    INSA        0                                                  00024410
07643  002                 CAB                                                            00024420
07644  203                 SLB1                              B_B*2                        00024430
07645  024                 AIA                                                            00024440
07646  370                 OCT         370                                                00024450
07647  622 675             JOV         SHALT                                              00024460
07651  616 653             J      I    STABLEP                                            00024470
07653  557 076    STABLEP  DAC    I3   *+2                                                00024480
07655  000 070             DAC         TEST0                                              00024490
07657  020 000             DAC         TEST1                                              00024500
07661  340 070             DAC         TEST2                                              00024510
07663  520 070             DAC         TEST3                                              00024520
07665  200 071             DAC         TEST4                                              00024530
07667  720 071             DAC         TEST5                                              00024540
07671  540 051             DAC         TEST6                                              00024550
07673  000 040             DAC         TEST7                                              00024560
07675  164 766    SHALT    JST    I    $HALT                                              00024570
07677  612 642             J           STEST                                              00024580
                           EJT                                                            00024590
```

```
                  ************************************************************************
                  *                    CARTRIDGE OVERLAY READ ROUTINE                    
                  ************************************************************************
  07700                    ORG       7700B
07700  172 733  AALOOP    LD        AA
07702  102 735            ADD       AAONE
07704  122 733            STD       AA
07706  112 737            SUD       AAFINAL          STARTING LOCATION + 1
07710  742 721            JZED      AASTART
07712  270                OCI       0                ENTER DEVICE NUMBER HERE
07713  010                OCT       10               OCI READ
07714  320                INAS      0                DEVICE NUMBER HERE
07715  612 714            J         *-1
07717  612 700            J         AALOOP
07721  020      AASTART   LIA                        THE COUNT IN AB IS THE NUMBER
07722  000                OCT       0                OF OCTAL WORDS TO BE OVERLAYED
07723  022                LIB
07724  220                OCT       220
07725  014                COMD
07726  360                SIM       0                DEVICE NUMBER HERE
07727  004 400            OCTD      4400
07731  164 766            JST   I   $HALT
07733  000 000  AA        DAC       0
07735  000 001  AAONE     OCTD      1
07737  004 401  AAFINAL   OCTD      4401
                  ************************************************************************
                  ************************************************************************
                           END
```

SYMBOL	DEFINED	REFERENCES
AA	007733	07700 07704
AAFINAL	007737	07706
AALOOP	007700	07717
AAONE	007735	07702
AASTART	007721	07710
ADDD	005140	05102 05112 05122 05132
AMAGB1	005455	05232
AMAGB2	005457	05251
AMAGM	005244	05240
AMAG	005226	05224
ARS1A	005263	05244 05257
ARS1B	005300	05274
ARS3A	005315	05311
ARS3B	005332	05326
ATLA	002746	02741
ATMIB	000752	00745
AUG	007616	07204 07210 07216 07220 07224 07250 07254 07262 07264 07270 07306 07312 07320 07322 07326 07344 07350 07356 07360 07364 07402 07406 07414 07416 07422 07440 07444 07452 07454 07460 07476 07502 07510 07512 07516 07524 07530
BCDRP	003572	03564 03570
BCDR	005000	05441 05445
BLANK	007107	07114
BOMBUF	004244	04234 04305
BOM1	004233	04065
BOM2	004304	04067
CKADD	004454	04402
CLOC	003462	03502
COUNT	000756	00725
CPU	000000	05416
DDIJB	003461	03410 03412 03416 03420 03472 03476
DECR	003412	03457
DIJB1	007227	07200
DIJB2	007273	07244
DIJB3	007331	07302
DIJB4	007367	07340
DIJB5	007425	07376
DIJB6	007463	07434
DIJB7	007521	07472
DJADDR	005461	05200 05220
DJPNTR	005463	05202 05204 05206 05222
DJ1	002412	02410
DJ2	002414	02416
DMCBUF	004452	04340 04371 04410 04450 04454
DMCCOUNT	004446	04342 04361
DMCPOINT	004450	04344 04363
FAIL1	007617	07214 07234
FAIL2	007621	07260
FAIL3	007623	07316
FAIL4	007625	07354
FAIL5	007627	07412
FAIL6	007631	07450
FAIL7	007633	07506
FAIL8	007635	07534
FAIL9	007637	07542

SYMBOL	DEFINED	REFERENCES
GOBAK	006772	06774
HADA	003176	NOT USED
HADB	003101	NOT USED
HADD	003253	NOT USED
HAIAX	002236	NOT USED
HAIA	002223	NOT USED
HAIBX	002264	NOT USED
HAIB	002247	NOT USED
HALT	003574	00766 03600 03614
HARS1	000467	NOT USED
HARS3	000553	NOT USED
HCAB	002047	NOT USED
HCDMC2	000747	NOT USED
HCOMA	002102	NOT USED
HCOMB	002162	NOT USED
HCOMD	002150	NOT USED
HDIJB	003511	NOT USED
HDIJB1	003470	NOT USED
HDIJB2	003522	NOT USED
HDJ	002404	02376 02402
HDJ2	002425	NOT USED
HDRS	002721	NOT USED
HEAB	002116	NOT USED
HEAIX	002315	NOT USED
HEAI	002300	NOT USED
HEBIX	002347	NOT USED
HEBI	002331	NOT USED
HEIAX	002360	NOT USED
HEIA	000124	00120
HEIBX	002373	NOT USED
HEIB	000144	00140
HIRS	003044	NOT USED
HJ	000036	NOT USED
HJCT2	002656	02652
HJCT	002646	NOT USED
HJEVD	002611	NOT USED
HJEVD2	002621	02615
HJEV2	002567	02563
HJEV	002557	NOT USED
HJMI2	002517	02513
HJMI	002507	NOT USED
HJNCT2	002670	02664
HJNCT3	002676	NOT USED
HJNOV	002467	NOT USED
HJNOV2	002501	02475
HJNZD	002630	02624
HJNZD2	002636	NOT USED
HJODD	002575	NOT USED
HJODD2	002604	02600
HJOD2	002552	02546
HJOD	002543	NOT USED
HJOV2	002447	02443
HJOV3	002457	NOT USED
HJOV	002435	NOT USED

SYMBOL	DEFINED	REFERENCES
HJPL2	002535	NOT USED
HJPL	002527	02523
HJST	003362	NOT USED
HJZED	000164	00172
HJZE	000154	NOT USED
HLB	002707	NOT USED
HLD	003404	NOT USED
HLDMC	000740	NOT USED
HLIAX	002175	NOT USED
HLIBX	002212	NOT USED
HLIB	000070	00064
HMIA	002036	NOT USED
HMIB2	002024	NOT USED
HMIB	002011	NOT USED
HOLD1	005071	05074
HOLD	007101	07112
HPCKA	002060	NOT USED
HPCKA4	002071	NOT USED
HPZCR	003561	NOT USED
HPZCS	003551	NOT USED
HRLA1	000355	NOT USED
HRLA3	000423	NOT USED
HRLB1	000367	NOT USED
HRLB3	000435	NOT USED
HRLD3	000723	NOT USED
HRLM1	002743	NOT USED
HRRA1	000344	NOT USED
HRRA3	000412	NOT USED
HRRB1	000333	NOT USED
HRRB3	000401	NOT USED
HRRD1	000622	NOT USED
HRRD3	000671	NOT USED
HSLA1	000236	NOT USED
HSLA3	000307	NOT USED
HSLB1	000253	NOT USED
HSLB3	000321	NOT USED
HSLD1	000504	NOT USED
HSLD3	000570	NOT USED
HSLD3B	000605	NOT USED
HSMAG	003345	NOT USED
HSRA1	000225	NOT USED
HSRA3	000276	NOT USED
HSRB1	000214	NOT USED
HSRB3	000265	NOT USED
HSRD1	000452	NOT USED
HSRD3	000536	NOT USED
HSTA	003223	NOT USED
HSTB	003127	NOT USED
HSTD	003302	NOT USED
HSTZ	003067	NOT USED
HSUA	003206	NOT USED
HSUBA	003027	NOT USED
HSUB	003112	NOT USED
HSUD	003265	NOT USED

SYMBOL	DEFINED	REFERENCES
HXAB	002133	NOT USED
HXMA	003241	NOT USED
HXMB	003145	NOT USED
HXMD	003317	NOT USED
HZED2	000107	00101
HZED	000105	00076
H223	000521	NOT USED
H231	000637	NOT USED
H233	000654	NOT USED
H235	000706	NOT USED
INAS1	004144	04047
INAS2	004441	04051
INSA1	004125	04102
INTSTAT	000770	00010 00022
IOINIT	004000	04007
IOINI2	004011	04005
IOTEND	004420	04414
JMIA	005427	05410
JMIB	005447	05431 05437
JMIC	005435	05447
JSTD	003300	03270 03276
JXMD	003315	03305 03313
KLSDB	005006	05106
KLSD	005100	05013
KNT	007157	07162
K2SDB	005022	05116
K2SD	005110	05031
K3SDB	005040	05126
K3SD	005120	05045
K4SDB	005054	05136
K4SD	005130	05061
LOOP11	007206	07226
LOOP22	007252	07272
LOOP3	007310	07330
LOOP4	007346	07366
LOOP5	007404	07424
LOOP6	007442	07462
LOOP7	007500	07520
MNRET	006776	06772
MPNT	000004	00020 00030
MREAD	004435	04162 04200 04217 04350 04444
MWRITE	004427	04136 04155 04170 04210 04365 04433
NUM	005150	05000 05004 05020 05036 05052 05100 05104 05110 05114 05120 05124 05130 05134
NUMBER	007166	07120 07124 07132 07141 07147
OCI10	004437	04035
OCI1	004123	04013
OCI2	004431	04015
OCI3	004142	04017
OCI4	004230	04021
OCI5	004247	04023
OCI6	004276	04025
OCI7	004314	04027
OCI8	004346	04031
OCI9	004373	04033

SYMBOL	DEFINED	REFERENCES
DIR1	004160	04110
DIR2	004367	04112
DIS1	004213	04057
ONE	002712	NOT USED
ONES1	005152	05002
ONES	007170	07122
ONE2	003563	03021 03414
OTAR1	004141	04041
OTAS1	004175	04074
PNTR1	007556	07172
PNTR11	007576	07174 07212
PNTR2	007560	07236
PNTR22	007600	07240 07256
PNTR3	007562	07274
PNTR33	007602	07276 07314
PNTR4	007564	07332
PNTR44	007604	07334 07352
PNTR5	007566	07370
PNTR55	007606	07372 07410
PNTR6	007570	07426
PNTR66	007610	07430 07446
PNTR7	007572	07464
PNTR77	007612	07466 07504
PNTR8	007574	NOT USED
PNTR88	007614	NOT USED
POINT	000760	00727
POINT2	000762	00742
P3ENT	000754	00002
P3START	006774	00754
RDIJB	003472	03466
RESTOR	005220	05214
ROTAT	000171	00202
RSTA	003216	03212 03217
RTCR	000022	00016
SAVAB	003616	03576 03607
SDRS	002725	02713 02715 02717
SEAIX	002310	02304 02311
SEAI	002273	02270 02274
SEBIX	002342	02336 02343
SEBI	002324	02321 02325
SHALT	007675	07647
SIMBUF	004263	04253 04265 04317 04325 04327
SIM1	004252	04117
SIM2	004324	04121
SIRS	003033	03036 03040 03042 03046
SJST	003366	03347 03351 03353 03370
SLB	002703	02700
SLC	002745	02726 02730 02734
SMAGA	005370	05364
SMAG	005347	05343
SPNTR	005453	05353 05356
SPNTRA	005451	05374 05402
SSTB	003121	03116 03122
STABLEP	007653	07651

SYMBOL	DEFINED	REFERENCES
START	003071	03012 03057 03061 03063
STEST	007642	00764 05425 07013 07047 07116 07164 07544 07677
STESTA	005425	05423
STESTP	000764	00000 04425 05076 05162
SUM	007051	07034 07045
SUPTST	005200	03572
SXMA	003236	03225 03233
SXMB2	003166	03151 03154 03156
SXMB	003142	03131 03135
TAB1	007546	07556 07576
TAB2	007547	07560 07600
TAB3	007550	07562 07602
TAB4	007551	07564 07604
TAB5	007552	07566 07606
TAB6	007553	07570 07610
TAB7	007554	07572 07612
TAB8	007555	07532 07574 07614
TADA	003167	03162 03172
TADB	003072	03065
TADD	003243	03237 03247
TAIAX	002225	02221
TAIA	002214	02210
TAI8X	002251	02245
TAI8	002240	02234
TAMAG	003321	03312 03325
TARS1	000454	00450
TARS3	000540	00534
TBDM2	004275	04271
TBDM	004227	04223
TCAB	002040	02034
TCDMC2	000742	00736
TCDMA	002073	02067
TCDMB	002152	02146
TCDMD	002135	02131
TDIJB	003406	03402
TDIJB2	003513	03507
TDJ	002375	02371
TDMCR	004360	04354
TDMCR1	004410	04404
TDMCW	004337	04333
TDRS	002711	02705
TEAB	002104	02100
TEAIX	002302	02276
TEAI	002266	02262
TEBIX	002333	02327
TEBI	002317	02313
TEIAX	002351	02345
TEIA	000111	00103
TEI8X	002362	02356
TEI8	000126	00122
TEST0	007000	07011 07655
TEST1	000002	07657
TEST2	007034	07661
TEST3	007052	07663

SYMBOL	DEFINED	REFERENCES
TEST4	007120	07665
TEST5	007172	07667
TEST6	005154	07671
TEST7	004000	07673
TIDX2	003532	03526
TIDX	003524	03520
TIRS	003034	03025 03031
TJ	000034	06776
TJCT2	002650	02644
TJCT	002640	02634
TJEVD	002606	02602
TJEVD2	002613	02607
TJEV2	002561	02555
TJEV	002554	02550
TJMI2	002511	02505
TJMI	002503	02477
TJNCT2	002660	02654
TJNCT3	002672	02666
TJNOV	002461	02455
TJNOV2	002471	02465
TJNZD	002623	02617
TJNZD2	002632	02626
TJODD	002571	02565
TJODD2	002577	02573
TJOD2	002545	02541
TJOD	002537	02533
TJOV2	002437	02433
TJOV3	002451	02445
TJOV	002427	02423
TJPL2	002531	02525
TJPL	002521	02515
TJST	003347	03343 03357
TJZED	000156	00152
TJZED2	000166	00162
TJZE	000146	00142
TLA	003007	02746
TLB	002700	02674
TLD	003374	03360 03364 03401
TLDMC	000725	00721
TLIAX	002164	02160
TLIA	000040	00034
TLIBX	002177	02173
TLIB2	000057	00053
TLIB	000046	00042
TMIA	002026	02013 02022
TMIB2	002013	02007
TMIB	002000	00752
TNOOP	002120	02114
TOIR1	004157	NOT USED
TOIR	004155	04151
TOIS1	004212	NOT USED
TOIS	004210	04204
TOTAR	004134	04130
TOTAR1	004140	NOT USED

SYMBOL	DEFINED	REFERENCES
TOTAS	004170	04164
TOTASI	004174	NOT USED
TPCKA	002051	02045
TPCKA2	002062	02056
TPZCR	003553	03547
TPZC	003543	03537
TRLA1	000346	00342
TRLA3	000414	00410
TRLB1	000357	00353
TRLB3	000425	00421
TRLD3	000710	00673 00704
TRLM1	002726	02723
TRRA1	000335	00331
TRRA3	000403	00377
TRRB1	000323	00317
TRRB3	000371	00365
TRRD1	000607	00572 00603
TRRD3	000656	00624 00652
TRTC	003564	03557
TSIM1	004265	04257
TSIM2	004313	04307
TSIM	004246	04240
TSLA1	000227	00223
TSLA3	000300	00274
TSLB1	000240	00234
TSLB3	000311	00305
TSLD1	000471	00465
TSLD3	000555	00551
TSLD3B	000572	00566
TSMAG	003335	03331 03341
TSRA1	000216	00212
TSRA3	000267	00262
TSRB1	000204	00176
TSRB3	000255	00251
TSRD1	000437	00433
TSRD3	000523	00506 00517
TSTA	003210	03204
TSTB	003114	03110
TSTD	003267	03263
TSTZ	003055	03051 03074 03105
TST7SP	005414	NOT USED
TSUA	003200	03174 03202
TSUBA	003020	03014
TSUB	003103	03077
TSUD	003255	03251 03261
TXAB	002120	NOT USED
TXMA	003225	03221
TXMB2	003147	03143
TXMB	003131	03125
TXMD	003304	03275
TZED	000072	00066
T223	000506	00502
T231	000624	00620
T233	000641	00635

SYMBOL	DEFINED	REFERENCES
T235	000673	00667
$HALT	000766	00004 00032 00036 00044 00055 00070 00105 00107 00124 00144 00154 00164 00214 00225
		00236 00253 00265 00276 00307 00321 00333 00344 00355 00367 00401 00412 00423 00435
		00452 00467 00504 00521 00536 00553 00570 00605 00622 00637 00654 00671 00706 00723
		00740 00747 02011 02024 02036 02047 02060 02071 02102 02116 02133 02150 02162 02175
		02212 02223 02236 02247 02264 02300 02315 02331 02347 02360 02373 02404 02425 02435
		02447 02457 02467 02501 02507 02517 02527 02535 02543 02552 02557 02567 02575 02604
		02611 02621 02630 02636 02646 02656 02670 02676 02707 02721 02743 03016 03027 03044
		03053 03067 03101 03112 03127 03145 03164 03176 03206 03223 03241 03253 03265 03302
		03317 03333 03345 03362 03372 03404 03470 03511 03522 03530 03541 03551 03561 04132
		04153 04166 04206 04225 04242 04261 04273 04311 04335 04356 04406 04416 04423 05160
		05216 05242 05261 05276 05313 05330 05345 05366 05412 05421 05433 05443 07617 07621
		07623 07625 07627 07631 07633 07635 07637 07675 07731

LOCATIONS USED
00000 - 00770
02000 - 02747
03007 - 03617
04000 - 04455
05000 - 05163
05200 - 05464
06772 - 07014
07034 - 07700
07700 - 07740

********** NO ERRORS THIS ASSEMBLY.

********** 432 SYMBOLS USED THIS ASSEMBLY.
********** 658 REFERENCES THIS ASSEMBLY.

SECTION 7

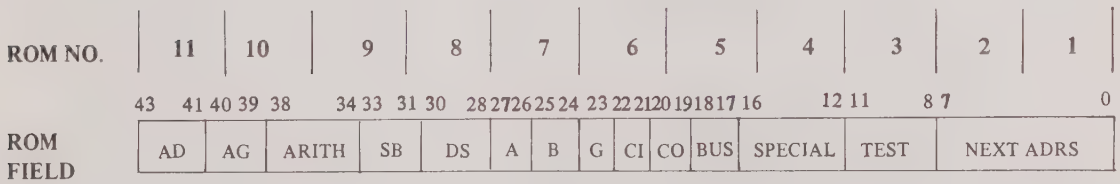
MEMORY SET 925E MICROPROGRAM ROMs
Part Number 70110-508-000

(Engineering Release Date: June 22, 1976)

The Microprogram ROMs (MPR) contain the microprograms for all instructions and for all manual control functions. The MPR comprises eleven ROMs (4 X 256 each), forming a control word 44-bits wide and a total of 256 words. The field definition of a control word is illustrated in Figure 1, the operation codes for each field are defined in Table 1, and the address and content of each MPR location are listed in Table 2. Table 3 is a further breakdown on Table 2, that is, the corresponding binary pattern of each MPR location.

Since the microprogram steps are not necessarily in successive MPR locations, refer to the 925E Microprogram Flow Diagrams (Section 8) that illustrate the macro sequence of all microprogram routines.

PART NUMBER	BITS	925E CPU LOCATION
70110-508-001	0–3	0708, Board No. 2
70110-508-002	4–7	0707, Board No. 2
70110-508-003	8–11	0709, Board No. 2
70110-508-004	12–15	0706, Board No. 2
70110-508-005	16–19	0807, Board No. 4
70110-508-006	20–23	0706, Board No. 3
70110-508-007	24–27	0808, Board No. 4
70110-508-008	28–31	0809, Board No. 4
70110-508-009	32–35	0707, Board No. 3
70110-508-010	36–39	0708, Board No. 3
70110-508-011	40–43	0709, Board No. 3



AD	-	Addent MPXR input select
AG	-	Augend MPXR input select
ARITH	-	ALU function select
SB	-	Sumbus MPXER input select
DS	-	Register set (MA, P, DC, or DP)
A	-	A register set, or Toggle on Parity
B	-	B register set
G	-	G register set
CI	-	ALU carry in select
CO	-	Carry and overflow control
BUS	-	Memory read or write select
SPECIAL	-	Special codes used to perform unique operations such as raising IO lines, setting flip-flops, selecting control panel for display, etc.
TEST	-	Selects appropriate conditions for microprogram branching, such as branch on contents of I-register, jump conditions, I/O reply, etc.
NEXT ADDRESS	-	Contains the absolute address of the next ROM location to be accessed in the MICROPROGRAM – this absolute address may be modified, depending on the branch condition selected by the TEST field. If the TEST field is zero the absolute address is the actual address of the next ROM location to be accessed.

Figure 7-1. Microprogram ROM Field

TABLE 1. 925E MICROPROGRAM ROM WORD (44-BITS) FIELD DEFINITION

PROGRAM LISTING

```
925E MICROPROGRAM ROM WORD (44-BITS ) FIELD DEFINITION----------
ADDEND    43-41
          000     MA
          001     P
          010     DC
          011     DP
          100     MA15-10, MB9-1
          101     MB9-1, G9-4
          110     A
          111     B
AUGEND    40-39
          00      MB
          01      G
          10      A
          11      B
ALU       38-34
          00000   AD + CI(1)
          00001   AD/
          00111   ZERO
          01011   AG/
          01100   AD - AG - CI/(1)
          01101   AD EXD AG
          10010   AD + AG
          10101   AG
          10111   AD LOGICAL AND AG
          11101   AD LOGICAL OR AG
          11110   AD - CI/(1)
          11111   AD
SUM BUS   33-31
          000     I/O INPUT
          001     SUM RL3
          010     SUM RS6
          011     SUM RR3
          100     SUM RL1
          101     SUM RR1
          110     SUM
          111     SUM (GATED BY I2/)
DATA SET  30-28
          000     NO OPERATION
          001     MA
          010     P
          011     DC
          100     DP
          101     MB FROM SB,MD OTHERWISE
          110     DC AND DP
          111     MA AND DP
A SET     27-26
          00      TOGGLE FOR PARITY
          01      SET FROM SUM BUS
          10      SET FROM B
          11      NO OPERATION
```

TABLE 1. (Continued)

PROGRAM LISTING

B SET	25-24	
	00	SET FROM SUM BUS
	01	SET FROM SUM BUS
	10	SET FROM A
	11	NO OPERATION
G SET	23	
	0	NO OPERATION
	1	SET G FROM MB
CI	22-21	
	00	CI/=1
	01	CI/=0
	10	CI/=CTP/
	11	CI/=CTI/
CO	20-19	
	00	HOLD CTP OV
	01	CTP AND OV SET AND RESET ENABLE
	10	CTP AND OV SET ENABLE
	11	HOLD CTI
MEM	18-17	
	00	READ
	01	WRITE
	10	READ
	11	NO OPERATION
SPECIAL	16-12	(HEX)
	00	
	01	SET I1-9
	02	SET I1-3
	03	IF I1A9, AG OUT IS 001, 000 IF NOT
	04	IF CTI, AG OUT IS 002, 000 IF NOT
	05	IF I1A9, AG OUT IS 002, 000 IF NOT
	06	DISABLE ADDEND
	07	AG OUT IS 010 IF I1I2/, 020 IF I1/I2, 000 IF NOT EITHER
	08	DISABLE AG IF I1/ OR I2/
	09	DISABLE AG6-9
	0A	DISABLE INTERRUPT
	0B	AG OUT IS 001 IF A9
	0C	AG OUT IS 002
	0D	DISABLE AD10-15
	0E	DISABLE SB1-3
	0F	DISABLE SHIFT LOGIC
	10	SELECT B TO SHIFT
	11	SELECT A TO SHIFT
	12	SELECT A9 AND MB TO SHIFT
	13	SET CPD
	14	(SPARE)
	15	SET CPC
	16	ENABLE DDV
	17	ENABLE INTERRUPT
	18	ENABLE PANEL DATA ENTRY TO INPUT BUS
	19	SET HALT FF
	1A	RESET LOAD FF MC1
	1B	SIM OR BOM TO DMC EXIT

TABLE 1. (Continued)

PROGRAM LISTING

```
          1C      DMC EXIT
TEST      11-08   (HEX)
          0       NO BRANCH (BR)
          1       BR TO START OF INSTR
          2       BR ON A9(AMAG OR SMAG)
          3       BR ON CTI
          4       BR TO INDIRECT OR E1
          5       BR TO END (HALT,INT,DMC,OR F1)
          6       JUMP TEST
          7       BR TO E2
          8       BR ON MB9
          9       BR ON MB9/
          A       BR ON MD1 EXO MD2
          B       BR ON PCR
          C       BR ON CTI/ OR PCES
          D       BR ON PANEL SWITCHES
          E       BR ON I4 I3 I2
          F       BR ON PCE
```

TABLE 2. 925E MICROPROGRAM ROM CONTENTS (HEX) AND ADDRESS TAGS (MNEMONICS)

PROGRAM LISTING

925E MICROPROGRAM ROM CONTENTS (HEX) AND ADDRESS TAGS (MNEMONICS)

000	00	0000F061D0F	IDLE STATE
001	01	0000F060018	STEP PROGRAM
002	02	2031F260016	P+1
003	03	27B1F060016	P-1
004	04	00007078000	ENTER A
005	05	0000D078000	ENTER B
006	06	0002F07800C	ENTER P
007	07	27F1F06000F	ENTER M
010	08	07F2F060017	WAIT-2 = NO INTERRUPT
011	09	01F250600EF	INITIATE PROGRAM LOAD
012	0A	07F2F06001A	WAIT-3 DMC OUT
013	0B	07F2F06001B	WAIT-4 DMC IN
014	0C	27F1F060016	P INTO MA FOR ENTER P
015	0D	0571F06A0A5	WAIT-5 INTERRUPT
016	0E	27F1F060016	WAIT-6 MANUAL HALT
017	0F	0005F07803C	LOAD MB
020	10	4033F276011	DMCI-2
021	11	0005F074012	DMCI-3
022	12	67F7F03C009	DMCI-4
023	13	4033F256014	DMCO-2
024	14	67F0F074015	DMCO-3
025	15	67F7F07C009	DMCO-4
026	16	07F2F040000	DISPLAY DATA FOR P+1 OR P-1
027	17	0032F24117F	F-2
030	18	27F1F060017	F-1
031	19		
032	1A	6037F273013	DMCO-1
033	1B	6037F273010	DMCI-1
034	1C	2032F240E37	IMM-1
035	1D	0571F06A0A5	INTERRUPT
036	1E	27F1F060016	MANUAL HALT
037	1F		
040	20	27F1F079016	HALT INSTRUCTION
041	21	0000806051F	CBA
042	22	0000E06051F	CAB
043	23	01F0506051F	ZED
044	24	1570306051F	PCKA
045	25	133072E651F	CUMA
046	26	DB70D06051F	EAB
047	27	0000F06051F	NOOP
050	28	0000F06050F	WAIT-1
051	29	0000A06051F	XAB
052	2A	0000F077018	ENI
053	2B	67C8D06F039	COMC-1
054	2C	1B30D26603A	COMD-1
055	2D	1B30D2E651F	COMB
056	2E	0000F06A018	DSI
057	2F	E4B0D06B03B	IDX-1
060	30	87F0706051F	LIA
061	31	87F0D06051F	LIB

TABLE 2. (Continued)

PROGRAM LISTING

```
062   32   C4B070E051F   AIA
063   33   E4B0D0E051F   AIB
064   34   C375F060038   EAI
065   35   E375F060038   EBI
066   36   C370706051F   EIA
067   37   E370D06051F   EIB
070   38   0000F020051F   RESTORE
071   39   67D0706051F   COMC=2
072   3A   133076E651F   COMD=2
073   3B   D03076E051F   IDX=2
074   3C   0000F020002   WRITE INTO MEMORY
075   3D   24B2F04CE37   IMX=2
076   3E   04B1F26B03D   IMX=1
077   3F   27F1F06001C   IMM
100   40   E7E8D06F51F   SRB1
101   41   C7E8706F51F   SRA1
102   42   C7E0706F51F   SLA1
103   43   E7E0D06F51F   SLB1
104   44   E7D8D06F51F   SRB3
105   45   C7D8706F51F   SRA3
106   46   C7C8706F51F   SLA3
107   47   E7C8D06F51F   SLB3
110   48   E7E8D06051F   RRB1
111   49   C7E8706051F   RRA1
112   4A   C7E0706051F   RLA1
113   4B   E7E0D06051F   RLB1
114   4C   E7D8D06051F   RRB3
115   4D   C7D8706051F   RRA3
116   4E   C7C8706051F   RLA3
117   4F   E7C8D06051F   RLB3
120   50   E7E8D0710A8   SRD1=1
121   51   E7E8D0710A9   ARS1=1
122   52   C7E070700AA   SLD1=1
123   53   0000F06051F   NOP
124   54   E7D8D0710AB   SRD3=1
125   55   E7D8D0710AC   ARS3=1
126   56   C7C870700AD   SLD3=1
127   57   0000F06051F   NOP
130   58   E7F5F0600AE   RRD1=1
131   59   0000F06051F   NOP
132   5A   C7F5F060083   RLD1
133   5B   0000F06051F   NOP
134   5C   E7F5F060085   RRD3=1
135   5D   0000F06051F   NOP
136   5E   C7F5F06008A   RLD3=1
137   5F   0000F06051F   NOP
140   60   0031F2600F0   MIA=1
141   61   0031F2600F2   MIB=1
142   62   0000F06051F   NOP
143   63   0000F06051F   NOP
144   64   0031F2600F4   MIMA=1
145   65   0000F06051F   NOP
```

TABLE 2. (Continued)

PROGRAM LISTING

```
146  66  0000F06051F  NOP
147  67  0000F06051F  NOP
150  68  1B30D26606C  FMD-4
151  69  84B9F0654FF  FMD-3
152  6A  0032F240269  FMD-2
153  6B  27F1F06006A  FMD-1
154  6C  13307766069  FMD-5
155  6D
156  6E  84B9F0634FF  FMS-3
157  6F  27F1F060072  FMS-1
160  70  0032F26051F  DIJB-5
161  71  0000F06051F  DIJB-6
162  72  0032F24006E  FMS-2
163  73  0031F2607FF  IUS
164  74  24B2F245076  JMC-3
165  75  24B2F26551F  JMC-2
166  76  84B9F0654FF  JMC-4
167  77  27F1F060075  JMC-1
170  78  0031F2407FF  FMDX
171  79  8765F06D07A  DIJB-3
172  7A  0000F020371  DIJB-4
173  7B  27F1F86007C  DIJB-1
174  7C  2B32F049079  DIJB-2
175  7D  0000F06051F  JMC-6
176  7E  07F2F06051F  JMC-5
177  7F
200  80  0000F0407FF  EXX-1
201  81  87F0D06051F  LB
202  82  67F6F06051F  LUMC
203  83  8765F06D084  DRS-1
204  84  24B2F02451F  DRS-2
205  85  67E5F060038  RLM-1
206  86  67F0706051F  LA
207  87  E33072E051F  SUBA
210  88  6035F260064  IRS
211  89  01F5F060038  STZ
212  8A  E4B0D0E051F  ADB
213  8B  E330D2E051F  SUB
214  8C  E035F060038  STB
215  8D  E7F5F8600A2  XMB
216  8E  C4B070E051F  ADA
217  8F  C33072E051F  SUA
220  90  C7F5F060038  STA
221  91  C7F5F860092  XMA-1
222  92  0D70702051F  XMA-2
223  93
224  94  0570704008I  LD
225  95  C4B070C0096  ADD-1
226  96  E4B0D060097  ADD-2
227  97  D030776951F  ADD-3
230  98  C33070C0099  SUD-1
231  99  E330D260097  SUD-2
```

TABLE 2. (Continued)

PROGRAM LISTING

232	9A	C7F5F06009B	STD-1
233	9B	E7F5F02009C	STD-2
234	9C	0031F260038	STD-3
235	9D	C000F04009E	XMD-1
236	9E	C7F5F86009F	XMD-2
237	9F	0031F2200A0	XMD-3
240	A0	0D7070400A1	XMD-4
241	A1	E7F5F8600A2	XMD-5
242	A2	0D70D02051F	XMD-6
243	A3	0000F0608A7	AMAG-1
244	A4	0000F0609A7	SMAG-1
245	A5	27CDF06E0BC	JST-1
246	A6	C33070C0099	SMAG-2
247	A7	C4B070C0096	AMAG-2
250	A8	C7E8706F51F	SRD1-2
251	A9	C7E87072S1F	ARS1-2
252	AA	E7E0D06F51F	SLD1-2
253	AB	C7D8706F51F	SRD3-2
254	AC	C7D8707251F	ARS3-2
255	AD	E7C8D06F51F	SLD3-2
256	AE	E7E8D0710AF	RRD1-2
257	AF	E7F5F8600B0	RRD1-3
260	B0	0D70D0600B1	RRD1-4
261	B1	C7E870700B2	RRD1-5
262	B2	87F0D06051F	RRD1-6
263	B3	C7E07070084	RLD1-2
264	B4	E7E0D07251F	RLD1-3
265	B5	E7D8D0710B6	RRD3-2
266	B6	E7F5F860067	RRD3-3
267	B7	0D70D0600B8	RRD3-4
270	B8	C7D870700B2	RRD3-5
271	B9	0031F260CEF	SIM-8
272	BA	C7C870700BB	RLD3-2
273	BB	E7C8D07251F	RLD3-3
274	BC	0031F2200BD	JST-2
275	BD	27D5F0600BE	JST-3
276	BE	0032F22051F	JST-4
277	BF		
300	C0	04B1F0680C1	DISX-1
301	C1	24B2F04CBC3	DISX-2
302	C2	24B2F06C0C4	DISX-4
303	C3	0000F06051F	DISX-3
304	C4	87F0F07451F	DISX-5
305	C5	0032F240BC3	DIS
306	C6	0031F2400C7	BOM-1
307	C7	0032FA400C8	BOM-2
310	C8	A7F1F060009	BOM-3
311	C9	E030D2600CE	BOM-7
312	CA	87F0F0740C9	BOM-6
313	CB	0000F060FCD	BOM-5
314	CC	0000F060018	BOM-A
315	CD	0000F07B5DB	BOM-B

TABLE 2. (Continued)

PROGRAM LISTING

316	CE	D03076E00CF	BOM=8
317	CF	0031F260CCD	BOM=9
320	D0	2032F2400D1	OCI=1
321	D1	87F0F07551F	OCI=2
322	D2	0000F060BD5	OTAS=1
323	D3	C7F0F07451F	OTAS=4
324	D4	24B2F06C0D3	OTAS=3
325	D5	0000F06051F	OTAS=2
326	D6	C7F0F07451F	OTAR=2
327	D7	27B2F06051F	OTAR=3
330	D8	0000F060BEB	SIM=9
331	D9	0000F040BCB	BOM=4
332	DA	0000F060BD7	OTAR=1
333	DB	0000F060BDD	INAS=1
334	DC	24B2F06C0DE	INAS=3
335	DD	0000F06051F	INAS=2
336	DE	0000707451F	INAS=4
337	DF	0000707451F	INSA
340	E0	04B1F06B0E1	OIRX=1
341	E1	24B2F04CBE3	OIRX=2
342	E2	87F0F07451F	OIRX=4
343	E3	2332F06C51F	OIRX=3
344	E4	87F0F07451F	OIR=3
345	E5	2332F26C51F	OIR=2
346	E6	2032F240BE5	OIR=1
347	E7	0031F2400E8	SIM=1
350	E8	0032FA400E9	SIM=2
351	E9	A7F1F060BEB	SIM=3
352	EA	0005F0740EC	SIM=5
353	EB	0000F060FEF	SIM=4
354	EC	E030D2200ED	SIM=6
355	ED	D03076E00B9	SIM=7
356	EE	0000F07A018	SIM=A
357	EF	0000F07B5DB	SIM=B
360	F0	0032F2400F1	MIWA=2
361	F1	C5F0706051F	MIA=3
362	F2	0032F2400F3	MIB=2
363	F3	E5F0D06051F	MIB=3
364	F4	0032F2400F5	MIWA=2
365	F5	000070740F1	MIWA=3
366	F6	0031FBA03FB	IC=3
367	F7		
370	F8	8035F2600F9	IC=5
371	F9	A7F1F0204FF	IC=6
372	FA	0000F0400F8	IC=4
373	FB	0000F0400FE	IC=8
374	FC	84B5F0670F6	IC=2
375	FD	0031FA600FB	IC=7
376	FE	BCB1F0684FF	IC=9
377	FF	0000F042AFD	IC=1

TABLE 3. 925E MICROPROGRAM ROM CONTENTS IN HEX AND BINARY

OCT ADRS	HEX ADRS	CONTENTS HEX	AD	AG	AU	SB	DS	A	B	G	CI	CO	MEM	SPEC	TEST	NEXT
000	00	0000F061D0F	000	00	00000	000	000	11	11	0	00	00	11	00001	1101	00001111
001	01	0000F060018	000	00	00000	000	000	11	11	0	00	00	11	00000	0000	00011000
002	02	2031F260016	001	00	00000	110	001	11	11	0	01	00	11	00000	0000	00010110
003	03	27B1F060016	001	00	11110	110	001	11	11	0	00	00	11	00000	0000	00010110
004	04	00007078000	000	00	00000	000	000	01	11	0	00	00	11	11000	0000	00000000
005	05	0000D078000	000	00	00000	000	000	11	01	0	00	00	11	11000	0000	00000000
006	06	0002F07800C	000	00	00000	000	010	11	11	0	00	00	11	11000	0000	00001100
007	07	27F1F06000F	001	00	11111	110	001	11	11	0	00	00	11	00000	0000	00001111
010	08	07F2F060017	000	00	11111	110	010	11	11	0	00	00	11	00000	0000	00010111
011	09	01F250600EF	000	00	00111	110	010	01	01	0	00	00	11	00000	0000	11101111
012	0A	07F2F06001A	000	00	11111	110	010	11	11	0	00	00	11	00000	0000	00011010
013	0B	07F2F06001B	000	00	11111	110	010	11	11	0	00	00	11	00000	0000	00011011
014	0C	27F1F060016	001	00	11111	110	001	11	11	0	00	00	11	00000	0000	00010110
015	0D	0571F06A0A5	000	00	10101	110	001	11	11	0	00	00	11	01010	0000	10100101
016	0E	27F1F060016	001	00	11111	110	001	11	11	0	00	00	11	00000	0000	00010110
017	0F	0005F07803C	000	00	00000	000	101	11	11	0	00	00	11	11000	0000	00111100
020	10	4033F276011	010	00	00000	110	011	11	11	0	01	00	11	10110	0000	00010001
021	11	0005F074012	000	00	00000	000	101	11	11	0	00	00	11	10100	0000	00010010
022	12	67F7F03C009	011	00	11111	110	111	11	11	0	00	00	01	11100	0000	11011001

TABLE 3. (Continued)

OCT	HEX	CONTENTS	AD	AG	AU	SB	DS	A	B	G	CI	CO	MEM	SPEC	TEST	NEXT
046	26	D870Q06051F	110	11	01101	110	000	11	01	0	00	00	11	00000	0101	00011111
047	27	0000F06051F	000	00	00000	000	000	11	11	0	00	00	11	00000	0101	00011111
050	28	0000F06050F	000	00	00000	000	000	11	11	0	00	00	11	00000	0101	00001111
051	29	0000A06051F	000	00	00000	000	000	10	10	0	00	00	11	00000	0101	00011111
052	2A	0000F077018	000	00	00000	000	000	11	11	0	00	00	11	10111	0000	00011000
053	2B	67C8D06F039	011	00	11111	001	000	11	01	0	00	00	11	01111	0000	00111001
054	2C	1B30D26603A	000	11	01100	110	000	11	01	0	01	00	11	00110	0000	00111010
055	2D	1B30D2E651F	000	11	01100	110	000	11	01	0	01	01	11	00110	0101	00011111
056	2E	0000F06A018	000	00	00000	000	000	11	11	0	00	00	11	01010	0000	00011000
057	2F	E4B0D06B03B	111	00	10010	110	000	11	01	0	00	00	11	01011	0000	00111011
060	30	87F0706051F	100	00	11111	110	000	01	11	0	00	00	11	00000	0101	00011111
061	31	87F0D06051F	100	00	11111	110	000	11	01	0	00	00	11	00000	0101	00011111
062	32	C4B070E051F	110	00	10010	110	000	01	11	0	00	01	11	00000	0101	00011111
063	33	E4B0D0E051F	111	00	10010	110	000	11	01	0	00	01	11	00000	0101	00011111
064	34	C375F060038	110	00	01101	110	101	11	11	0	00	00	11	00000	0000	00111000
065	35	E375F060038	111	00	01101	110	101	11	11	0	00	00	11	00000	0000	00111000
066	36	C370706051F	110	00	01101	110	000	01	11	0	00	00	11	00000	0101	00011111
067	37	E370D06051F	111	00	01101	110	000	11	01	0	00	00	11	00000	0101	00011111
070	38	0000F02051F	000	00	00000	000	000	11	11	0	00	00	01	00000	0101	00011111

TABLE 3. (Continued)

OCT	HEX	CONTENTS	AD	AG	AU	SB	DS	A	B	G	CI	CO	MEM SPEC	TEST	NEXT
071	39	67D0706051F	011	00	11111	010	000	01	11	0	00	00	11 00000	0101	00011111
072	3A	133076E651F	000	10	01100	110	000	01	11	0	11	01	11 00110	0101	00011111
073	3B	D03076E051F	110	10	00000	110	000	01	11	0	11	01	11 00000	0101	00011111
074	3C	0000F020002	000	00	00000	000	000	11	11	0	00	00	01 00000	0000	00000010
075	3D	2482F04CE37	001	00	10010	110	010	11	11	0	00	00	10 01100	1110	00110111
076	3E	04B1F26B03D	000	00	10010	110	001	11	11	0	01	00	11 01011	0000	00111101
077	3F	27F1F06001C	001	00	11111	110	001	11	11	0	00	00	11 00000	0000	00011100
100	40	E7E6D06F51F	111	00	11111	101	000	11	01	0	00	00	11 01111	0101	00011111
101	41	C7E8706F51F	110	00	11111	101	000	01	11	0	00	00	11 01111	0101	00011111
102	42	C7E0706F51F	110	00	11111	100	000	01	11	0	00	00	11 01111	0101	00011111
103	43	E7E0D06F51F	111	00	11111	100	000	11	01	0	00	00	11 01111	0101	00011111
104	44	E7D8D06F51F	111	00	11111	011	000	11	01	0	00	00	11 01111	0101	00011111
105	45	C7D8706F51F	110	00	11111	011	000	01	11	0	00	00	11 01111	0101	00011111
106	46	C7C8706F51F	110	00	11111	001	000	01	11	0	00	00	11 01111	0101	00011111
107	47	E7C8D06F51F	111	00	11111	001	000	11	01	0	00	00	11 01111	0101	00011111
110	48	E7E8D06051F	111	00	11111	101	000	11	01	0	00	00	11 00000	0101	00011111
111	49	C7E8706051F	110	00	11111	101	000	01	11	0	00	00	11 00000	0101	00011111
112	4A	C7E0706051F	110	00	11111	100	000	01	11	0	00	00	11 00000	0101	00011111
113	4B	E7E0D06051F	111	00	11111	100	000	11	01	0	00	00	11 00000	0101	00011111

TABLE 3. (Continued)

OCT	HEX	CONTENTS	AD	AG	AU	SB	DS	A	B	G	CI	CO	MEM	SPEC	TEST	NEXT
114	4C	E7D8D06051F	111	00	11111	011	000	11	01	0	00	00	11	00000	0101	00011111
115	4D	C7D8706051F	110	00	11111	011	000	01	11	0	00	00	11	00000	0101	00011111
116	4E	C7C8706051F	110	00	11111	001	000	01	11	0	00	00	11	00000	0101	00011111
117	4F	E7C8D06051F	111	00	11111	001	000	11	01	0	00	00	11	00000	0101	00011111
120	50	E7E8D0710A8	111	00	11111	101	000	11	01	0	00	00	11	10001	0000	10101000
121	51	E7E8D0710A9	111	00	11111	101	000	11	01	0	00	00	11	10001	0000	10101001
122	52	C7E070700AA	110	00	11111	100	000	01	11	0	00	00	11	10000	0000	10101010
123	53	0000F06051F	000	00	00000	000	000	11	11	0	00	00	11	00000	0101	00011111
124	54	E7D8D0710AB	111	00	11111	011	000	11	01	0	00	00	11	10001	0000	10101011
125	55	E7D8D0710AC	111	00	11111	011	000	11	01	0	00	00	11	10001	0000	10101100
126	56	C7C870700AD	110	00	11111	001	000	01	11	0	00	00	11	10000	0000	10101101
127	57	0000F06051F	000	00	00000	000	000	11	11	0	00	00	11	00000	0101	00011111
130	58	E7F5F0600AE	111	00	11111	110	101	11	11	0	00	00	11	00000	0000	10101110
131	59	0000F06051F	000	00	00000	000	000	11	11	0	00	00	11	00000	0101	00011111
132	5A	C7F5F060083	110	00	11111	110	101	11	11	0	00	00	11	00000	0000	10110011
133	5B	0000F06051F	000	00	00000	000	000	11	11	0	00	00	11	00000	0101	00011111
134	5C	E7F5F0600B5	111	00	11111	110	101	11	11	0	00	00	11	00000	0000	10110101
135	5D	0000F06051F	000	00	00000	000	000	11	11	0	00	00	11	00000	0101	00011111
136	5E	C7F5F0600BA	110	00	11111	110	101	11	11	0	00	00	11	00000	0000	10111010

TABLE 3. (Continued)

OCT	HEX	CONTENTS	AD	AG	AU	SB	DS	A	B	G	CI	CO	MEM	SPEC	TEST	NEXT
137	5F	0000F06051F	000	00	00000	000	000	11	11	0	00	00	11	00000	0101	00011111
140	60	0031F2600F0	000	00	00000	110	001	11	11	0	01	00	11	00000	0000	11110000
141	61	0031F2600F2	000	00	00000	110	001	11	11	0	01	00	11	00000	0000	11110010
142	62	0000F06051F	000	00	00000	000	000	11	11	0	00	00	11	00000	0101	00011111
143	63	0000F06051F	000	00	00000	000	000	11	11	0	00	00	11	00000	0101	00011111
144	64	0031F2600F4	000	00	00000	110	001	11	11	0	01	00	11	00000	0000	11110100
145	65	0000F06051F	000	00	00000	000	000	11	11	0	00	00	11	00000	0101	00011111
146	66	0000F06051F	000	00	00000	000	000	11	11	0	00	00	11	00000	0101	00011111
147	67	0000F06051F	000	00	00000	000	000	11	11	0	00	00	11	00000	0101	00011111
150	68	1830D26606C	000	11	01100	110	000	11	01	0	01	00	11	00110	0000	01101100
151	69	84B9F0654FF	100	00	10010	111	001	11	11	0	00	00	11	00101	0100	11111111
152	6A	0032F240269	000	00	00000	110	010	11	11	0	01	00	10	00000	0010	01101001
153	6B	27F1F06006A	001	00	11111	110	001	11	11	0	00	00	11	00000	0000	01101010
154	6C	13307766069	000	10	01100	110	000	01	11	0	11	10	11	00110	0000	01101001
155	6D		000	00	00000	000	000	00	00	0	00	00	00	00000	0000	00000000
156	6E	84B9F0634FF	100	00	10010	111	001	11	11	0	00	00	11	00011	0100	11111111
160	70	0032F26051F	000	00	00000	110	010	11	11	0	01	00	11	00000	0101	00011111
157	6F	27F1F060072	001	00	11111	110	001	11	11	0	00	00	11	00000	0000	01110010
161	71	0000F06051F	000	00	00000	000	000	11	11	0	00	00	11	00000	0101	00011111

TABLE 3. (Continued)

OCT	HEX	CONTENTS	AD	AG	AU	SB	DS	A	B	G	CI	CO	MEM	SPEC	TEST	NEXT
162	72	0032F24006E	000	00	00000	110	010	11	11	0	01	00	10	00000	0000	01101110
163	73	0031F2607FF	000	00	00000	110	001	11	11	0	01	00	11	00000	0111	11111111
164	74	24B2F245076	001	00	10010	110	010	11	11	0	01	00	10	00101	0000	01110110
165	75	24B2F26551F	001	00	10010	110	010	11	11	0	01	00	11	00101	0101	00011111
166	76	84B9F0654FF	100	00	10010	111	001	11	11	0	00	00	11	00101	0100	11111111
167	77	27F1F060675	001	00	11111	110	001	11	11	0	00	00	11	00000	0110	01110101
170	78	0031F2407FF	000	00	00000	110	001	11	11	0	01	00	10	00000	0111	11111111
171	79	87B5F06D07A	100	00	11110	110	101	11	11	0	00	00	11	01101	0000	01111010
172	7A	0000F020371	000	00	00000	000	000	11	11	0	00	00	01	00000	0011	01110001
173	7B	27F1F86007C	001	00	11111	110	001	11	11	1	00	00	11	00000	0000	01111100
174	7C	2B32F049079	001	01	01100	110	010	11	11	0	00	00	10	01001	0000	01111001
175	7D	0000F 6051F	000	00	00000	000	000	11	11	0	00	10	11	00000	0101	00011111
176	7E	07F2F06051F	000	00	11111	110	010	11	11	0	00	00	11	00000	0101	00011111
177	7F		000	00	00000	000	000	00	00	0	00	00	00	00000	0000	00000000
200	80	0000F0407FF	000	00	00000	000	000	11	11	0	00	00	10	00000	0111	11111111
201	81	87F0D06051F	100	00	11111	110	000	11	01	0	00	00	11	00000	0101	00011111
202	82	67F6F06051F	011	00	11111	110	110	11	11	0	00	00	11	00000	0101	00011111
203	83	87B5F060D04	100	00	11110	110	101	11	11	0	00	00	11	01101	0000	10000100
204	84	24B2F02451F	001	00	10010	110	010	11	11	0	00	00	01	00100	0101	00011111

TABLE 3. (Continued)

OCT	HEX	CONTENTS	AD	AG	AU	SB	DS	A	B	G	CI	CO	MEM	SPEC	TEST	NEXT
205	85	87E5F060038	100	00	11111	100	101	11	11	0	00	00	11	00000	0000	00111000
206	86	87F0706051F	100	00	11111	110	000	01	11	0	00	00	11	00000	0101	00011111
207	87	E33072E051F	111	00	01100	110	000	01	11	0	01	01	11	00000	0101	00011111
210	88	8035F26D084	100	00	00000	110	101	11	11	0	01	00	11	01101	0000	10000100
211	89	01F5F060038	000	00	00111	110	101	11	11	0	00	00	11	00000	0000	00111000
212	8A	E4B0D0E051F	111	00	10010	110	000	11	01	0	00	01	11	00000	0101	00011111
213	8B	E330D2E051F	111	00	01100	110	000	11	01	0	01	01	11	00000	0101	00011111
214	8C	E035F060038	111	00	00000	110	101	11	11	0	00	00	11	00000	0000	00111000
215	8D	E7F5F8600A2	111	00	11111	110	101	11	11	1	00	00	11	00000	0000	10100010
216	8E	C4B070E051F	110	00	10010	110	000	01	11	0	00	01	11	00000	0101	00011111
217	8F	C33072E051F	110	00	01100	110	000	01	11	0	01	01	11	00000	0101	00011111
220	90	C7F5F060038	110	00	11111	110	101	11	11	0	00	00	11	00000	0000	00111000
221	91	C7F5F860092	110	00	11111	110	101	11	11	1	00	00	11	00000	0000	10010010
222	92	0070702051F	000	01	10101	110	000	01	11	0	00	00	01	00000	0101	00011111
223	93		000	00	00000	000	000	00	00	0	00	00	00	00000	0000	00000000
224	94	05707040081	000	00	10101	110	000	01	11	0	00	00	10	00000	0000	10000001
225	95	C4B070C0096	110	00	10010	110	000	01	11	0	00	01	10	00000	0000	10010110
226	96	E4B0D060097	111	00	10010	110	000	11	01	0	00	00	11	00000	0000	10010111
227	97	D030776951F	110	10	00000	110	000	01	11	0	11	10	11	01001	0101	00011111

TABLE 3. (Continued)

OCT	HEX	CONTENTS	AD	AG	AU	SB	DS	A	B	G	CI	CO	MEM	SPEC	TEST	NEXT
230	98	C33070C0099	110	00	01100	110	000	01	11	0	00	01	10	00000	0000	10011001
231	99	E3300260097	111	00	01100	110	000	11	01	0	01	00	11	00000	0000	10010111
232	9A	C7F5F06009B	110	00	11111	110	101	11	11	0	00	00	11	00000	0000	10011011
233	9B	E7F5F02009C	111	00	11111	110	101	11	11	0	00	00	01	00000	0000	10011100
234	9C	0031F260038	000	00	00000	110	001	11	11	0	01	00	11	00000	0000	00111000
235	9D	0000F04009E	000	00	00000	000	000	11	11	0	00	00	10	00000	0000	10011110
236	9E	C7F5F86009F	110	00	11111	110	101	11	11	1	00	00	11	00000	0000	10011111
237	9F	0031F2200A0	000	00	00000	110	001	11	11	0	01	00	01	00000	0000	10100000
240	A0	0D7070400A1	000	01	10101	110	000	01	11	0	00	00	10	00000	0000	10100001
241	A1	E7F5F8600A2	111	00	11111	110	101	11	11	1	00	00	11	00000	0000	10100010
242	A2	0D70D02051F	000	01	10101	110	000	11	01	0	00	00	01	00000	0101	00011111
243	A3	0000F0608A7	000	00	00000	000	000	11	11	0	00	00	11	00000	1000	10100111
244	A4	0000F0609A7	000	00	00000	000	000	11	11	0	00	00	11	00000	1001	10100111
245	A5	27CDF06E0BC	001	00	11111	001	101	11	11	0	00	00	11	01110	0000	10111100
246	A6	C33070C0099	110	00	01100	110	000	01	11	0	00	01	10	00000	0000	10011001
247	A7	C4B070C0096	110	00	10010	110	000	01	11	0	00	01	10	00000	0000	10010110
250	A8	C7E8700F51F	110	00	11111	101	000	01	11	0	00	00	11	01111	0101	00011111
251	A9	C7E8707251F	110	00	11111	101	000	01	11	0	00	00	11	10010	0101	00011111
252	AA	E7E0D06F51F	111	00	11111	100	000	11	01	0	00	00	11	01111	0101	00011111

TABLE 3. (Continued)

OCT	HEX	CONTENTS	AD	AG	AU	SB	DS	A	B	G	CI	CO	MEM	SPEC	TEST	NEXT
253	AB	C7D8706F51F	110	00	11111	011	000	01	11	0	00	00	11	01111	0101	00011111
254	AC	C7D8707251F	110	00	11111	011	000	01	11	0	00	00	11	10010	0101	00011111
255	AD	E7C8D06F51F	111	00	11111	001	000	11	01	0	00	00	11	01111	0101	00011111
256	AE	E7E8D0710AF	111	00	11111	101	000	11	01	0	00	00	11	10001	0000	10101111
257	AF	E7F5F860080	111	00	11111	110	101	11	11	1	00	00	11	00000	0000	10110000
260	B0	0D70D0600B1	000	01	10101	110	000	11	01	0	00	00	11	00000	0000	10110001
261	B1	C7E870700B2	110	00	11111	101	000	01	11	0	00	00	11	10000	0000	10110010
262	B2	87F0D06051F	100	00	11111	110	000	11	01	0	00	00	11	00000	0101	00011111
263	B3	C7E07070084	110	00	11111	100	000	01	11	0	00	00	11	10000	0000	10110100
264	B4	E7E0D07251F	111	00	11111	100	000	11	01	0	00	00	11	10010	0101	00011111
265	B5	E7D8D071086	111	00	11111	011	000	11	01	0	00	00	11	10001	0000	10110110
266	B6	E7F5F8600B7	111	00	11111	110	101	11	11	1	00	00	11	00000	0000	10110111
267	B7	0D70D060088	000	01	10101	110	000	11	01	0	00	00	11	00000	0000	10111000
270	B8	C7D870700B2	110	00	11111	011	000	01	11	0	00	00	11	10000	0000	10110010
271	B9	0031F260CEF	000	00	00000	110	001	11	11	0	01	00	11	00000	1100	11101111
272	BA	C7C870700BB	110	00	11111	001	000	01	11	0	00	00	11	10000	0000	10111011
273	BB	E7C8D07251F	111	00	11111	001	000	11	01	0	00	00	11	10010	0101	00011111
274	BC	0031F22008D	000	00	00000	110	001	11	11	0	01	00	01	00000	0000	10111101
275	BD	27D5F06008E	001	00	11111	010	101	11	11	0	00	00	11	00000	0000	10111110

TABLE 3. (Continued)

OCT	HEX	CONTENTS	AD	AG	AU	SB	DS	A	B	G	CI	CO	MEM	SPEC	TEST	NEXT
276	BE	0032F22051F	000	00	00000	110	010	11	11	0	01	00	01	00000	0101	00011111
277	BF		000	00	00000	000	000	00	00	0	00	00	00	00000	0000	00000000
300	C0	04B1F06B0C1	000	00	10010	110	001	11	11	0	00	00	11	01011	0000	11000001
301	C1	24B2F04CBC3	001	00	10010	110	010	11	11	0	00	00	10	01100	1011	11000011
302	C2	24B2F06C0C4	001	00	10010	110	010	11	11	0	00	00	11	01100	0000	11000100
303	C3	0000F06051F	000	00	00000	000	000	11	11	0	00	00	11	00000	0101	00011111
304	C4	87F0F07451F	100	00	11111	110	000	11	11	0	00	00	11	10100	0101	00011111
305	C5	0032F2408C3	000	00	00000	110	010	11	11	0	01	00	10	00000	1011	11000011
306	C6	0031F2400C7	000	00	00000	110	001	11	11	0	01	00	10	00000	0000	11000111
307	C7	0032FA400C8	000	00	00000	110	010	11	11	1	01	00	10	00000	0000	11001000
310	C8	A7F1F0600D9	101	00	11111	110	001	11	11	0	00	00	11	00000	0000	11011001
311	C9	E030D2600CE	111	00	00000	110	000	11	01	0	01	00	11	00000	0000	11001110
312	CA	87F0F0740C9	100	00	11111	110	000	11	11	0	00	00	11	10100	0000	11001001
313	CB	0000F060FCD	000	00	00000	000	000	11	11	0	00	00	11	00000	1111	11001101
314	CC	0000F060018	000	00	00000	000	000	11	11	0	00	00	11	00000	0000	00011000
315	CD	0000F07B5DB	000	00	00000	000	000	11	11	0	00	00	11	11011	0101	11011011
316	CE	D03076E00CF	110	10	00000	110	000	01	11	0	11	01	11	00000	0000	11001111
317	CF	0031F260CCD	000	00	00000	110	001	11	11	0	01	00	11	00000	1100	11001101
320	D0	2032F240001	001	00	00000	110	010	11	11	0	01	00	10	00000	0000	11010001

TABLE 3. (Continued)

OCT	HEX	CONTENTS	AD	AG	AU	SB	DS	A	B	G	CI	CO	MEM	SPEC	TEST	NEXT
321	D1	87F0F07551F	100	00	11111	110	000	11	11	0	00	00	11	10101	0101	00011111
322	D2	0000F060BD5	000	00	00000	000	000	11	11	0	00	00	11	00000	1011	11010101
323	D3	C7F0F07451F	110	00	11111	110	000	11	11	0	00	00	11	10100	0101	00011111
324	D4	24B2F06C0D3	001	00	10010	110	010	11	11	0	00	00	11	01100	0000	11010011
325	D5	0000F06051F	000	00	00000	000	000	11	11	0	00	00	11	00000	0101	00011111
326	D6	C7F0F07451F	110	00	11111	110	000	11	11	0	00	00	11	10100	0101	00011111
327	D7	27B2F06051F	001	00	11110	110	010	11	11	0	00	00	11	00000	0101	00011111
330	D8	0000F060BEB	000	00	00000	000	000	11	11	0	00	00	11	00000	1011	11101011
331	D9	0000F040BCB	000	00	00000	000	000	11	11	0	00	00	10	00000	1011	11001011
332	DA	0000F060BD7	000	00	00000	000	000	11	11	0	00	00	11	00000	1011	11010111
333	DB	0000F060BDD	000	00	00000	000	000	11	11	0	00	00	11	00000	1011	11011101
334	DC	24B2F06C0DE	001	00	10010	110	010	11	11	0	00	00	11	01100	0000	11011110
335	DD	0000F06051F	000	00	00000	000	000	11	11	0	00	00	11	00000	0101	00011111
336	DE	0000707451F	000	00	00000	000	000	01	11	0	00	00	11	10100	0101	00011111
337	DF	0000707451F	000	00	00000	000	000	01	11	0	00	00	11	10100	0101	00011111
340	E0	04B1F06B0E1	000	00	10010	110	001	11	11	0	00	00	11	01011	0000	11100001
341	E1	24B2F04CBE3	001	00	10010	110	010	11	11	0	00	00	10	01100	1011	11100011
342	E2	87F0F07451F	100	00	11111	110	000	11	11	0	00	00	11	10100	0101	00011111
343	E3	2332F06C51F	001	00	01100	110	010	11	11	0	00	00	11	01100	0101	00011111

TABLE 3. (Continued)

OCT	HEX	CONTENTS	AD	AG	AU	SB	DS	A	B	G	CI	CO	MEM	SPEC	TEST	NEXT
344	E4	87F0F07451F	100	00	11111	110	000	11	11	0	00	00	11	10100	0101	00011111
345	E5	2332F20C51F	001	00	01100	110	010	11	11	0	01	00	11	01100	0101	00011111
346	E6	2032F240BE5	001	00	00000	110	010	11	11	0	01	00	10	00000	1011	11100101
347	E7	0031F2400E8	000	00	00000	110	001	11	11	0	01	00	10	00000	0000	11101000
350	E8	0032FA400E9	000	00	00000	110	010	11	11	1	01	00	10	00000	0000	11101001
351	E9	A7F1F060BEB	101	00	11111	110	001	11	11	0	00	00	11	00000	1011	11101011
352	EA	0005F0740EC	000	00	00000	000	101	11	11	0	00	00	11	10100	0000	11101100
353	EB	0000F060FEF	000	00	00000	000	000	11	11	0	00	00	11	00000	1111	11101111
354	EC	E030D2200ED	111	00	00000	110	000	11	01	0	01	00	01	00000	0000	11101101
355	ED	003076E00B9	110	10	00000	110	000	01	11	0	11	01	11	00000	0000	10111001
356	EE	0000F07A018	000	00	00000	000	000	11	11	0	00	00	11	11010	0000	00011000
357	EF	0000F07B5DB	000	00	00000	000	000	11	11	0	00	00	11	11011	0101	11011011
360	F0	0032F2400F1	000	00	00000	110	010	11	11	0	01	00	10	00000	0000	11110001
361	F1	C5F0706051F	110	00	10111	110	000	01	11	0	00	00	11	00000	0101	00011111
362	F2	0032F2400F3	000	00	00000	110	010	11	11	0	01	00	10	00000	0000	11110011
363	F3	E5F0D06051F	111	00	10111	110	000	11	01	0	00	00	11	00000	0101	00011111
364	FA	0032F2400F5	000	00	00000	110	010	11	11	0	01	00	10	00000	0000	11110101
365	F5	000070740F1	000	00	00000	000	000	01	11	0	00	00	11	10100	0000	11110001
366	F6	0031FBA03FB	000	00	00000	110	001	11	11	1	01	11	01	00000	0011	11111011

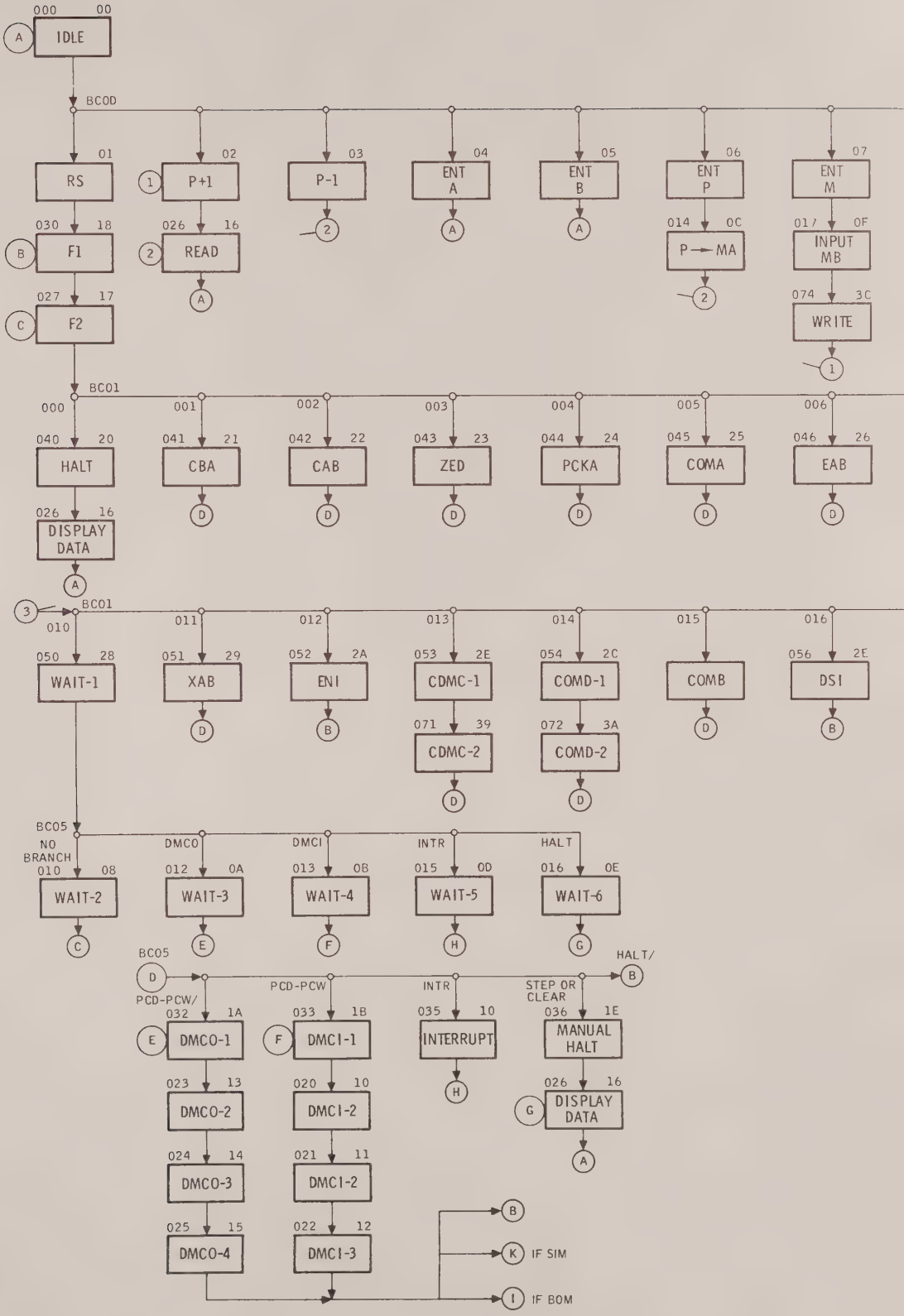
TABLE 3. (Continued)

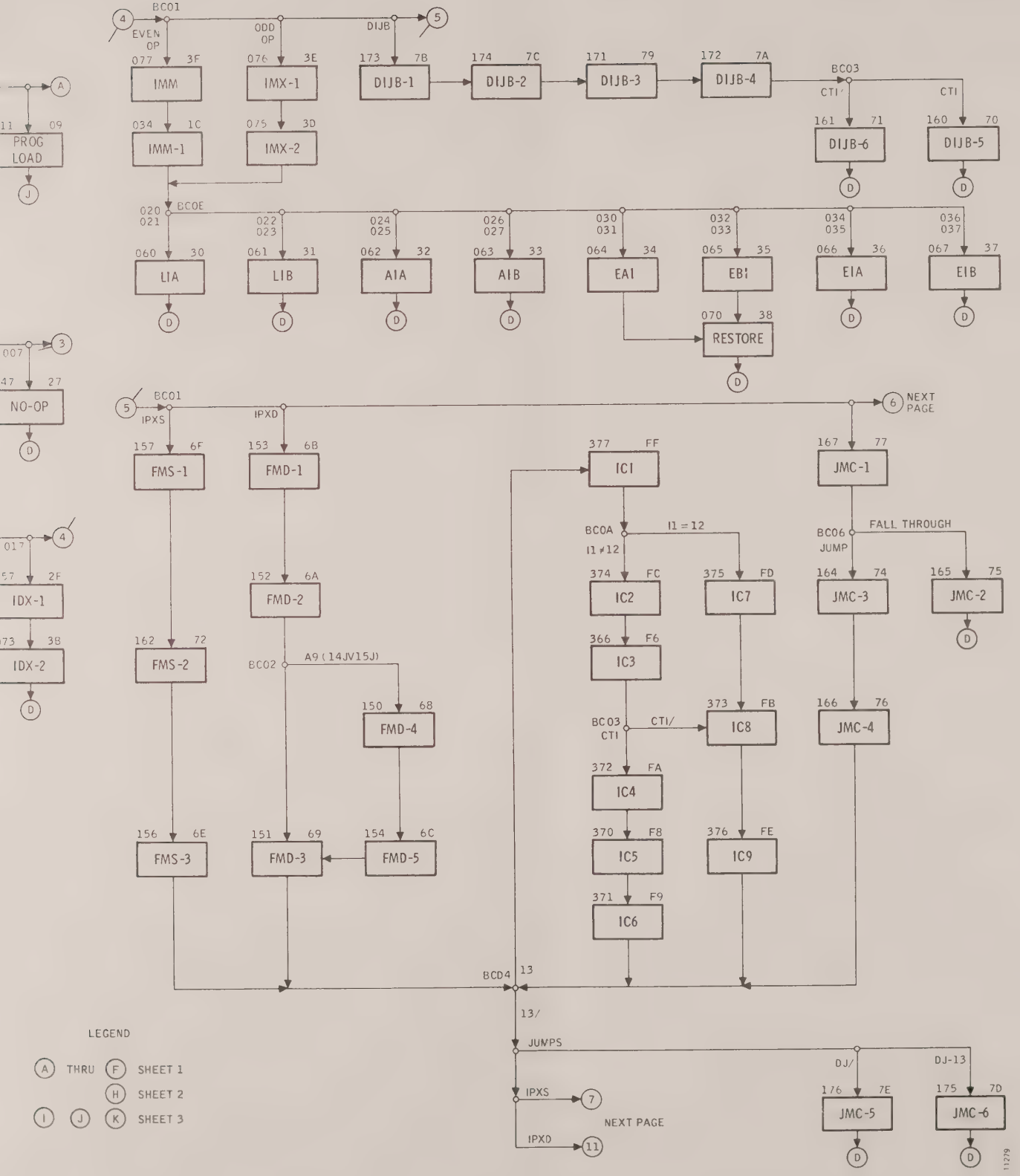
OCT	HEX	CONTENTS	AD	AG	AU	SB	DS	A	B	G	CI	CO	MEM SPEC	TEST	NEXT
367	F7		000	00	00000	000	000	00	00	0	00	00	00	00000	0000	00000000
370	F8	8035F2600F9	100	00	00000	110	101	11	11	0	01	00	11	00000	0000	11111001
371	F9	A7F1F0204FF	101	00	11111	110	001	11	11	0	00	00	01	00000	0100	11111111
372	FA	0000F0400F8	000	00	00000	000	000	11	11	0	00	00	10	00000	0000	11111000
373	FB	0000F0400FE	000	00	00000	000	000	11	11	0	00	00	10	00000	0000	11111110
374	FC	84B5F0670F6	100	00	10010	110	101	11	11	0	00	00	11	00111	0000	11110110
375	FD	0031FA600FB	000	00	00000	110	001	11	11	1	01	00	11	00000	0000	11111011
376	FE	BCB1F0684FF	101	11	10010	110	001	11	11	0	00	00	11	01000	0100	11111111
377	FF	0000F042AFD	000	00	00000	000	000	11	11	0	00	00	10	00010	1010	11111101

SECTION 8

925E INSTRUCTION MICROPROGRAM FLOW DIAGRAMS

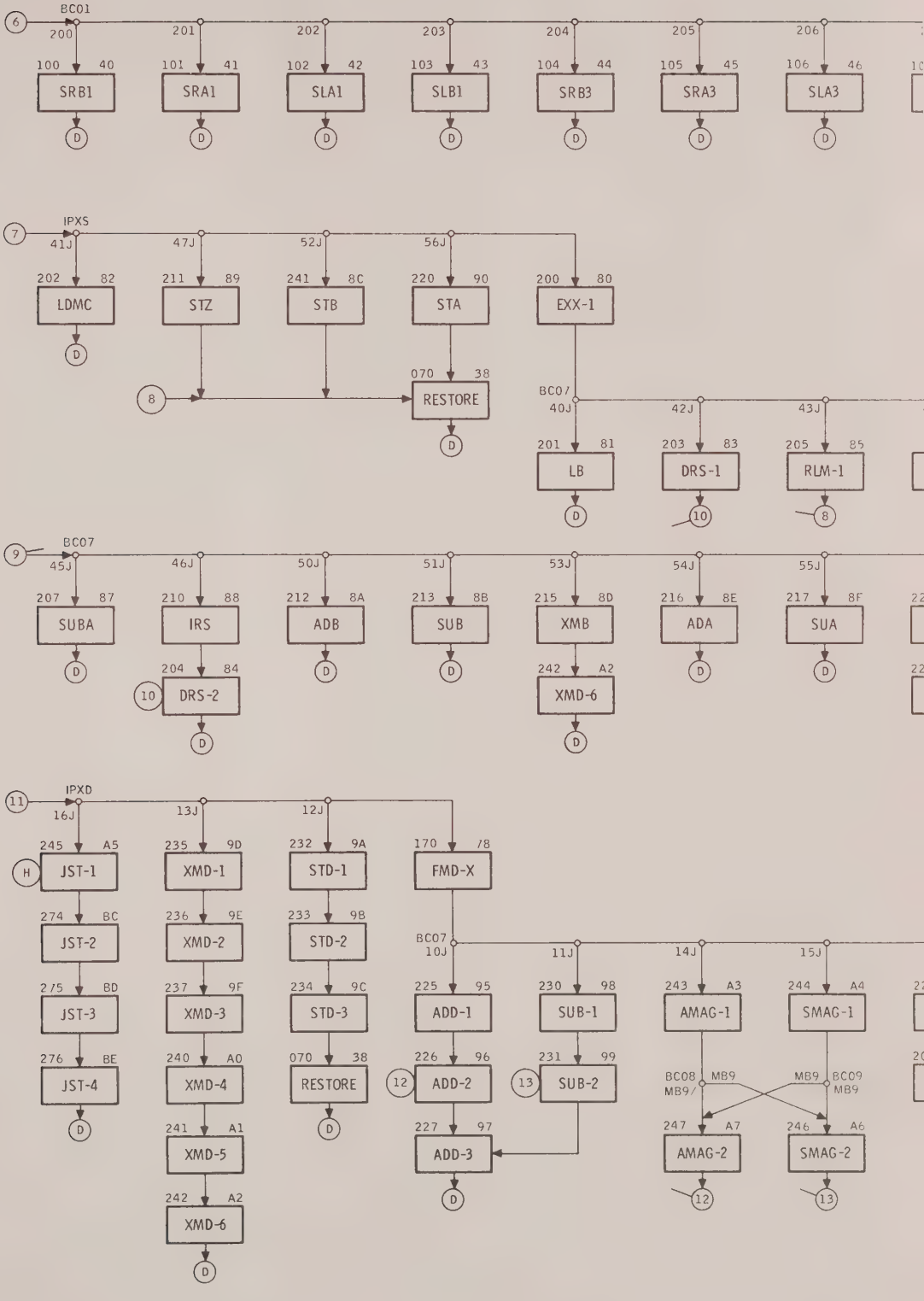
(May 4, 1975 – Engineering Release Date: June 22, 1976)

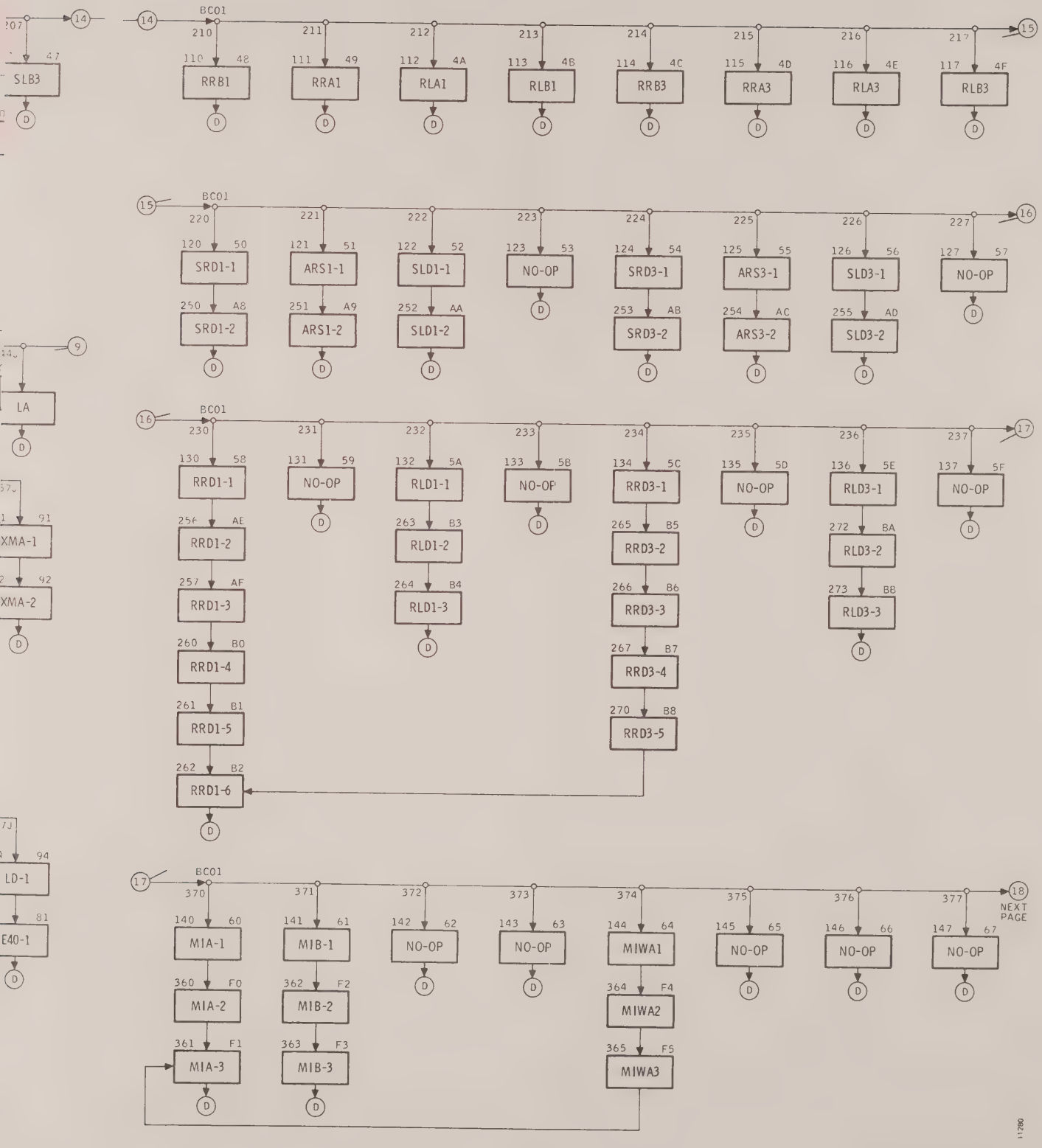

000 00
A
IDLE
BCOD
01
RS
02
1
P+1
03
P-1
04
ENT A
05
ENT B
06
ENT P
07
ENT M
030 18
B
F1
026 16
2
READ
014 0C
P → MA
017 0F
INPUT MB
027 17
C
F2
074 3C
WRITE
BC01
000
001
002
003
004
005
006
040 20
HALT
041 21
CBA
042 22
CAB
043 23
ZED
044 24
PCKA
045 25
COMA
046 26
EAB
026 16
DISPLAY DATA
3
BC01
010
011
012
013
014
015
016
050 28
WAIT-1
051 29
XAB
052 2A
ENI
053 2E
CDMC-1
054 2C
COMD-1
COMB
056 2E
DSI
071 39
CDMC-2
072 3A
COMD-2
BC05
NO BRANCH
DMCO
DMCI
INTR
HALT
010 08
WAIT-2
012 0A
WAIT-3
013 0B
WAIT-4
015 0D
WAIT-5
016 0E
WAIT-6
BC05
HALT/
PCD-PCW/
PCD-PCW
INTR
STEP OR CLEAR
032 1A
DMCO-1
033 1B
DMCI-1
035 10
INTERRUPT
036 1E
MANUAL HALT
023 13
DMCO-2
020 10
DMCI-2
026 16
DISPLAY DATA
024 14
DMCO-3
021 11
DMCI-2
025 15
DMCO-4
022 12
DMCI-3
IF SIM
IF BOM



Microprogram Flow Chart (Sheet 1)

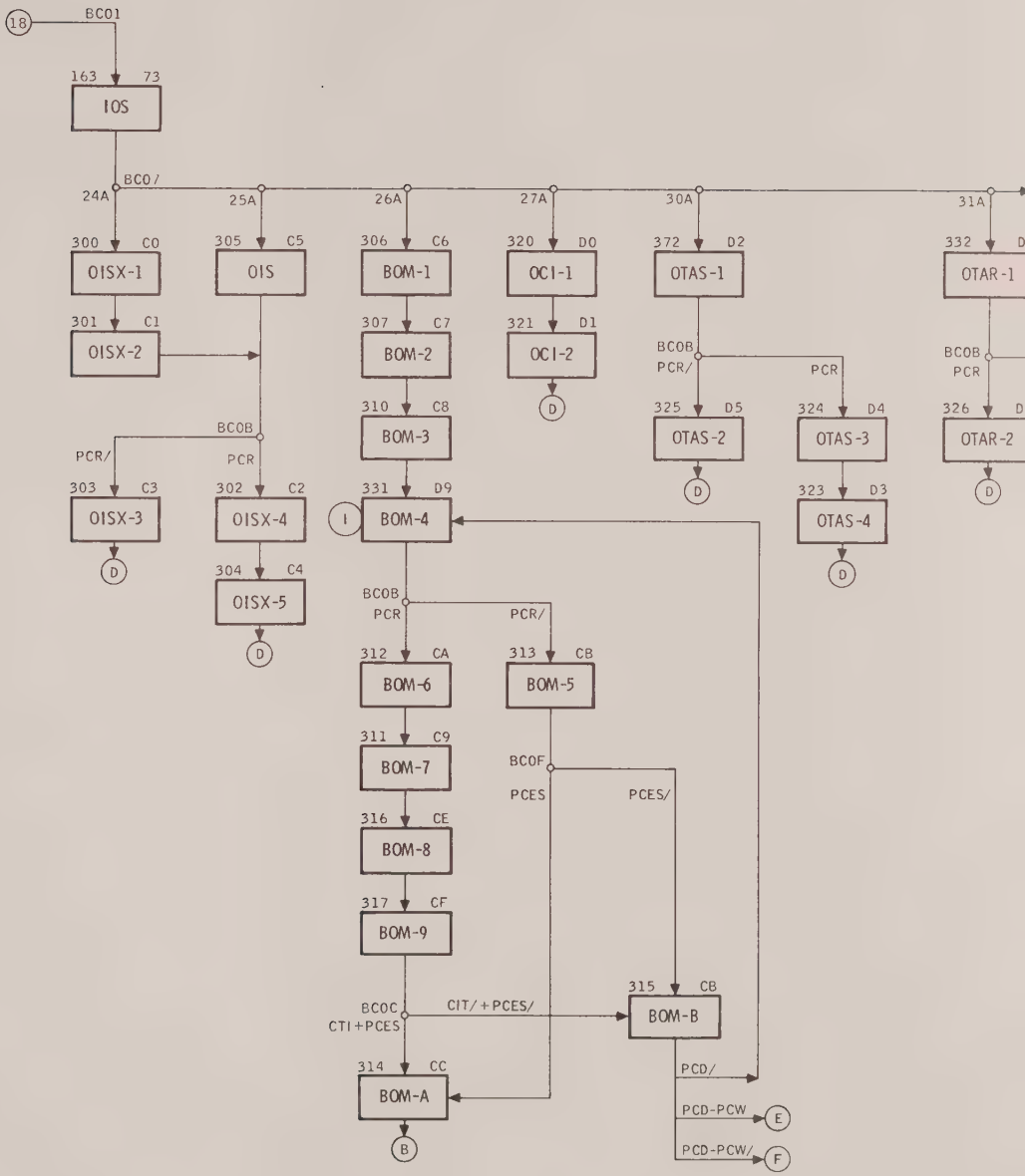
8-1

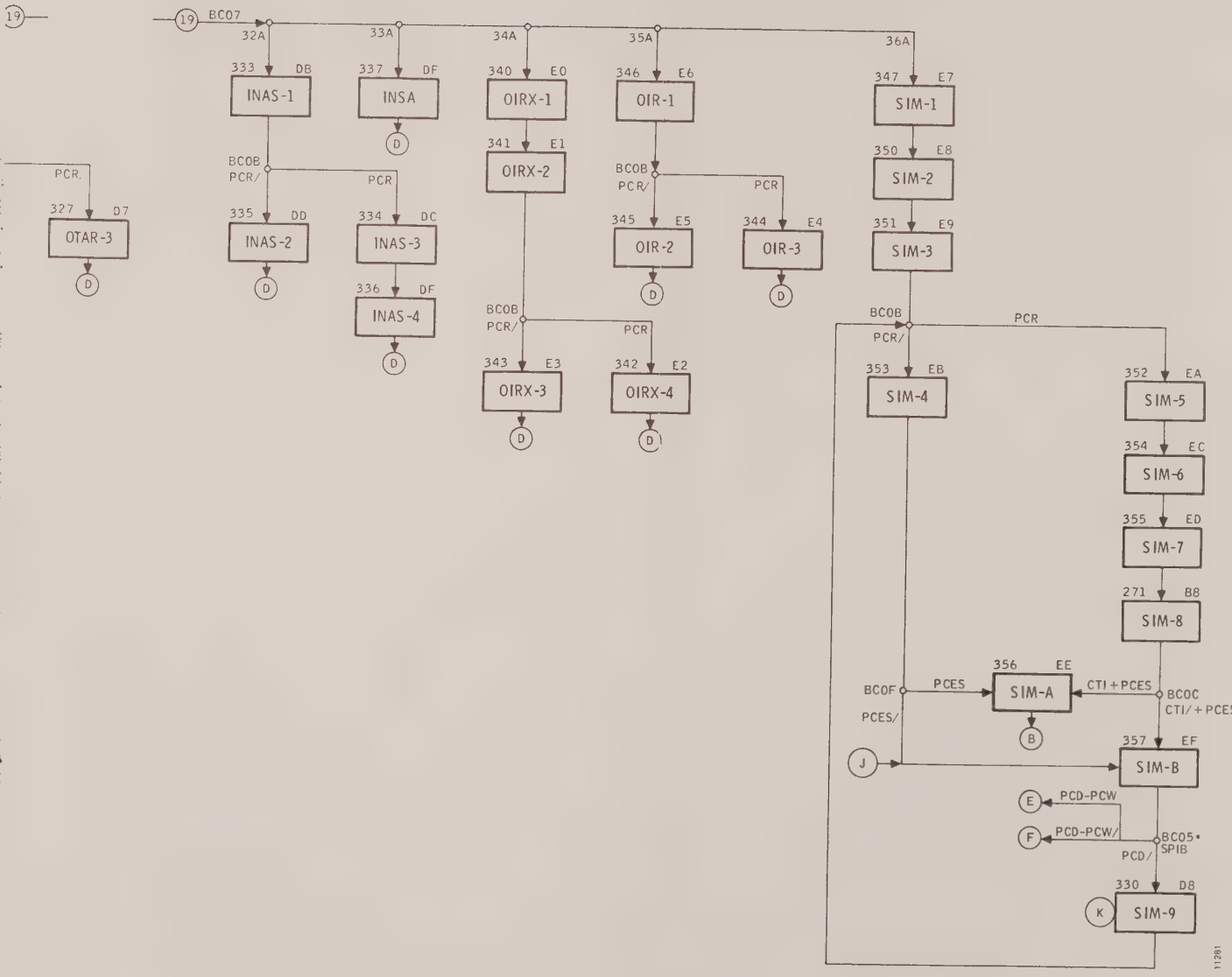

6
BC01
200
201
202
203
204
205
206
100 40
SRB1
101 41
SRA1
102 42
SLA1
103 43
SLB1
104 44
SRB3
105 45
SRA3
106 46
SLA3
D
7
IPXS
41J
47J
52J
56J
202 82
LDMC
211 89
STZ
241 8C
STB
220 90
STA
200 80
EXX-1
8
070 38
RESTORE
BC07
40J
42J
43J
201 81
LB
203 83
DRS-1
205 85
RLM-1
10
9
BC07
45J
46J
50J
51J
53J
54J
55J
207 87
SUBA
210 88
IRS
212 8A
ADB
213 8B
SUB
215 8D
XMB
216 8E
ADA
217 8F
SUA
204 84
DRS-2
242 A2
XMD-6
11
IPXD
16J
13J
12J
245 A5
H
JST-1
235 9D
XMD-1
232 9A
STD-1
170 78
FMD-X
274 BC
JST-2
236 9E
XMD-2
233 9B
STD-2
BC07
10J
11J
14J
15J
275 BD
JST-3
237 9F
XMD-3
234 9C
STD-3
225 95
ADD-1
230 98
SUB-1
243 A3
AMAG-1
244 A4
SMAG-1
276 BE
JST-4
240 A0
XMD-4
070 38
RESTORE
226 96
12
ADD-2
231 99
13
SUB-2
BC08
MB9
MB9
BC09
MB9
MB9
241 A1
XMD-5
227 97
ADD-3
247 A7
AMAG-2
246 A6
SMAG-2
242 A2
XMD-6



5B3

Microprogram Flow Chart (Sheet 2)

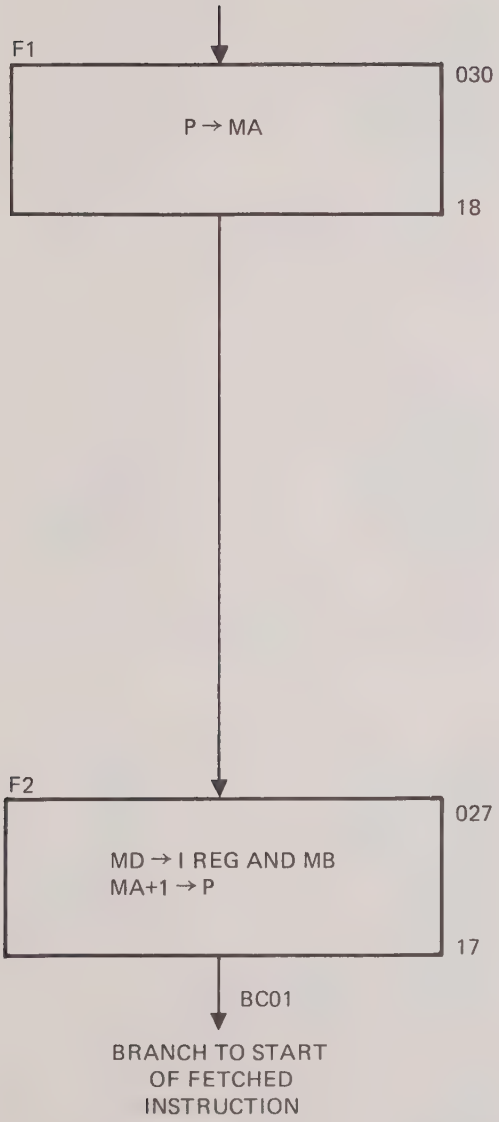

18
BC01
163
73
IOS
24A
BC0/
25A
26A
27A
30A
31A
300
C0
OISX-1
305
C5
OIS
306
C6
BOM-1
320
D0
OC1-1
372
D2
OTAS-1
332
OTAR-1
301
C1
OISX-2
307
C7
BOM-2
321
D1
OC1-2
BC0B
PCR/
PCR
310
C8
BOM-3
325
D5
OTAS-2
324
D4
OTAS-3
326
OTAR-2
303
C3
OISX-3
302
C2
OISX-4
331
D9
I
BOM-4
323
D3
OTAS-4
D
304
C4
OISX-5
312
CA
BOM-6
313
CB
BOM-5
311
C9
BOM-7
BC0F
PCES
PCES/
316
CE
BOM-8
317
CF
BOM-9
315
CB
BOM-B
BC0C
CTI+PCES
CIT/+PCES/
314
CC
BOM-A
PCD/
PCD-PCW
PCD-PCW/
E
F
B



Microprogram Flow Chart (Sheet 3)

5B4

FETCH CYCLES



ADDEND: 001
AUGEND: 00
ALU: 11111
SUM BUS: 110
DATA SET: 001
A SET: 11
B SET: 11

G SET: 0
CI: 00
CO: 00
MEM: 11
SPEC: 00000
TEST: 0000
NEXT: 17_H

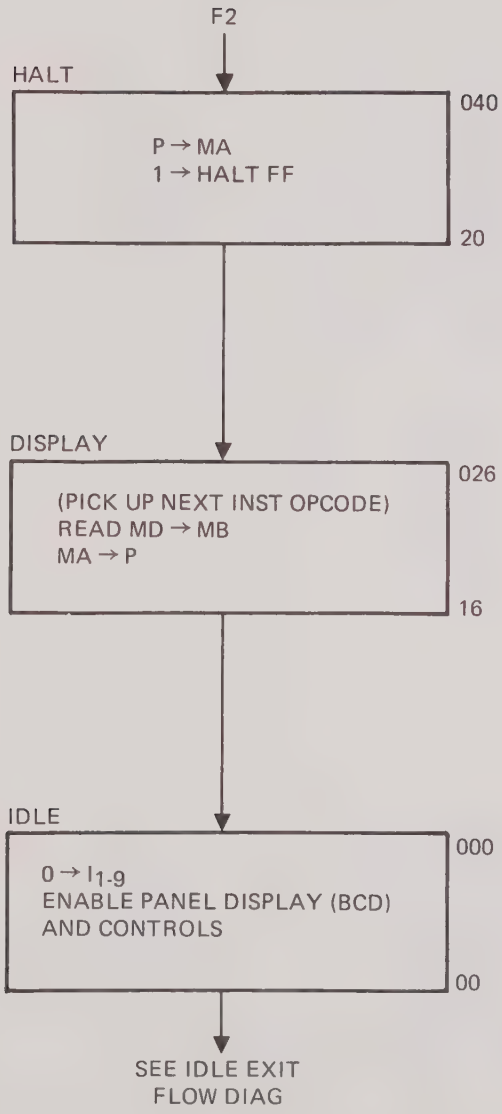
ROM WORD: $27F1F060017_H$

ADDEND: 000
AUGEND: 00
ALU: 00000
SUM BUS: 110
DATA SET: 010
A SET: 11
B SET: 11

G SET: 0
CI: 00
CO: 00
MEM: 10
SPEC: SP01
TEST: BC01
NEXT: $7F_H$

ROM WORD: $0032F24117F_H$

000 HALT



ADDEND: 001
AUGEND: 00
ALU: 11111
SUM BUS: 110
DATA SET: 001
A SET: 11
B SET: 11

G SET: 0
CI: 00
CO: 00
MEM: 11
SPEC: SP19
TEST: 00
NEXT: 16_H

ROM WORD: 27F1F079016

ADDEND: 000
AUGEND: 00
ALU: 11111
SUM BUS: 110
DATA SET: 010
A SET: 11
B SET: 11

G SET: 0
CI: 00
CO: 00
MEM: 10
SPEC: 00000
TEST: 0000
NEXT: 00_H

ROM WORD: 07F2F040000

ADDEND: 000
AUGEND: 00
ALU: 00000
SUM BUS: 000
DATA SET: 000
A SET: 11
B SET: 11

G SET: 0
CI: 00
CO: 00
MEM: 11
SPEC: SP01
TEST: BCD
NEXT: $0F_H$

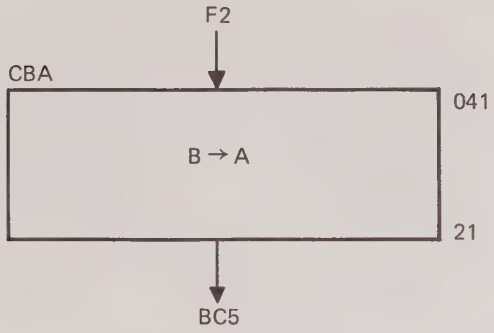
ROM WORD: 0000F061D0F

ADDEND:
AUGEND:
ALU:
SUM BUS:
DATA SET:
A SET:
B SET

G SET:
CI:
CO:
MEM:
SPEC:
TEST:
NEXT:

ROM WORD:

001 CBA COPY B INTO A

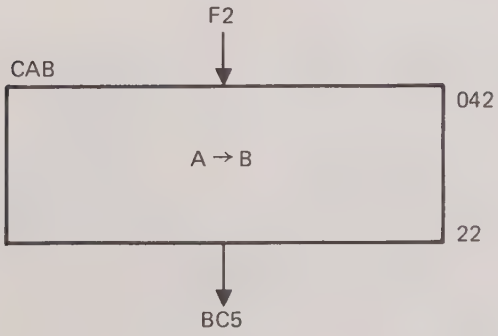


ADDEND: 000
AUGEND: 00
ALU: 00000
SUM BUS: 000
DATA SET: 000
A SET: 10
B SET: 11

G SET: 0
CI: 00
CO: 00
MEM: 11
SPEC: 00
TEST: BC5
NEXT: $1F_H$

ROM WORD: 0000B06051F

002 CAB COPY A INTO B

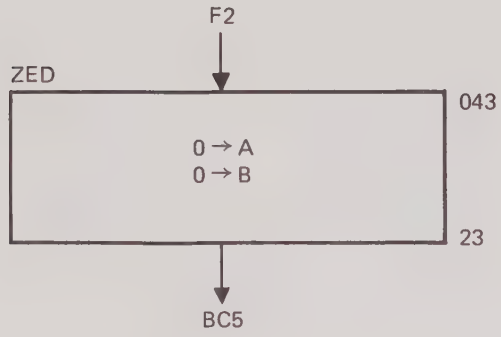


ADDEND: 000
AUGEND: 00
ALU: 00000
SUM BUS: 000
DATA SET: 000
A SET: 11
B SET: 10

G SET: 0
CI: 00
CO: 00
MEM: 11
SPEC: 00
TEST: BC5
NEXT: $1F_H$

ROM WORD: 0000$06051F

003 ZED ZERO DOUBLE (A AND B)

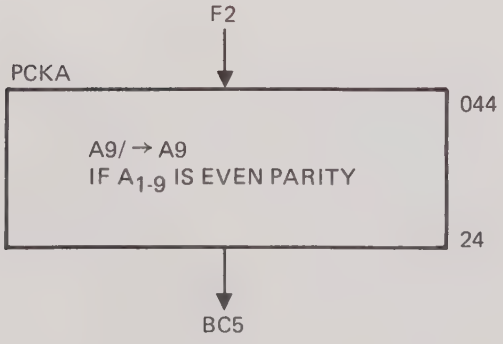


ADDEND: 000
AUGEND: 00
ALU: 00111
SUM BUS: 110
DATA SET: 000
A SET: 01
B SET: 01

G SET: 0
CI: 0
CO: 00
MEM: 11
SPEC: 00
TEST: BC5
NEXT: $1F_H$

ROM WORD: 01F0506051F

004 PCKA PARITY CHECK A

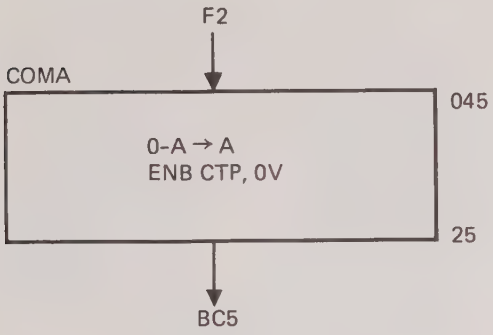


ADDEND: 000
AUGEND: 10
ALU: 10101
SUM BUS: 110
DATA SET: 000
A SET: 00
B SET: 11

G SET: 0
CI: 00
CO: 00
MEM: 11
SPEC: 00
TEST: BC5
NEXT: $1F_H$

ROM WORD: 1570306051F

005 COMA TWOS COMPLEMENT A, RESULT IN A

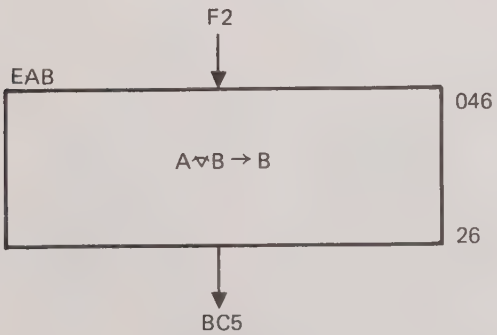


ADDEND: 000
AUGEND: 10
ALU: 01100
SUM BUS: 110
DATA SET: 000
A SET: 01
B SET: 11

G SET: 0
CI: 01
CO: 01
MEM: 11
SPEC: SP06
TEST: BC5
NEXT: 1F

ROM WORD: 133072E651F

006 EAB EXCLUSIVE-OR A AND B, RESULT IN B

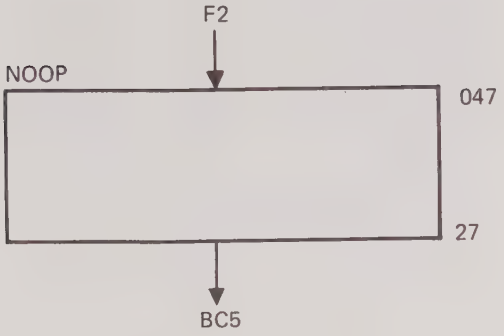


ADDEND: 110
AUGEND: 11
ALU: 01101
SUM BUS: 110
DATA SET: 000
A SET: 11
B SET: 01

G SET: 0
CI: 00
CO: 00
MEM: 11
SPEC: 00
TEST: BC5
NEXT: 1F

ROM WORD: DB70D06051F

007 NO OPERATION

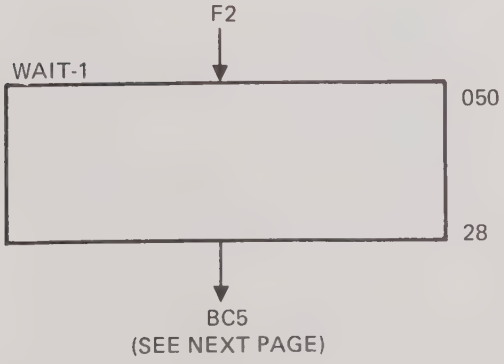


ADDEND: 000
AUGEND: 00
ALU: 0000
SUM BUS: 000
DATA SET: 000
A SET: 11
B SET: 11

G SET: 0
CI: 00
CO: 00
MEM: 11
SPEC: 0000
TEST: BC5
NEXT: 1F

ROM WORD: 0000F06051F

010 WAIT WAIT FOR INTERRUPT

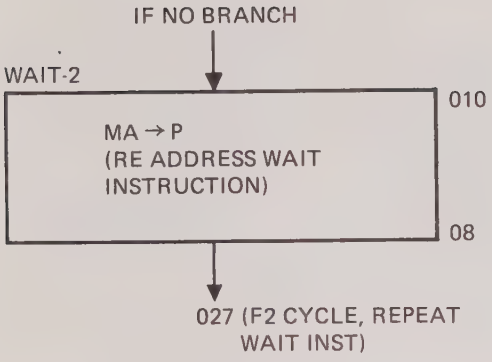


(SEE NEXT PAGE)

ADDEND: 000
AUGEND: 00
ALU: 0000
SUM BUS: 000
DATA SET: 000
A SET: 11
B SET: 11

G SET: 0
CI: 00
CO: 00
MEM: 11
SPEC: 0000
TEST: BC5
NEXT: 0F

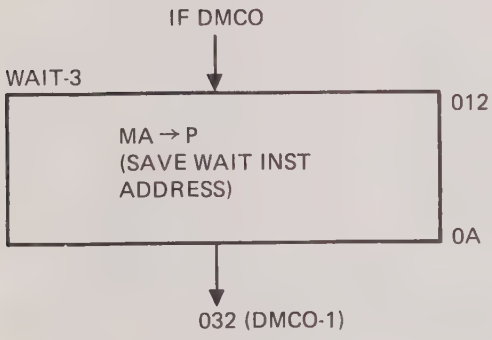
ROM WORD: 0000F06050F



ADDEND: 000
AUGEND: 00
ALU: 11111
SUM BUS: 110
DATA SET: 010
A SET: 11
B SET: 11

G SET: 0
CI: 00
CO: 00
MEM: 11
SPEC: 00000
TEST: 0000
NEXT: 17

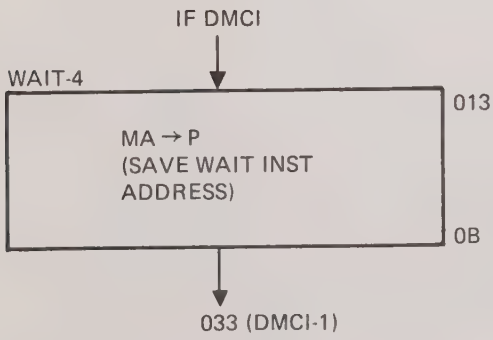
ROM WORD: 07F2F060017



ADDEND: 000
AUGEND: 00
ALU: 11111
SUM BUS: 110
DATA SET: 010
A SET: 11
B SET: 11

G SET: 0
CI: 00
CO: 00
MEM: 11
SPEC: 00000
TEST: 0000
NEXT: 1A

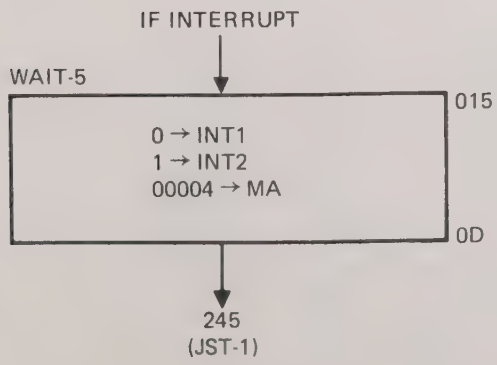
ROM WORD: 07F2F06001A



ADDEND: 000
AUGEND: 00
ALU: 11111
SUM BUS: 110
DATA SET: 010
A SET: 11
B SET: 11

G SET: 0
CI: 00
CO: 00
MEM: 11
SPEC: 00000
TEST: 0000
NEXT: 1B

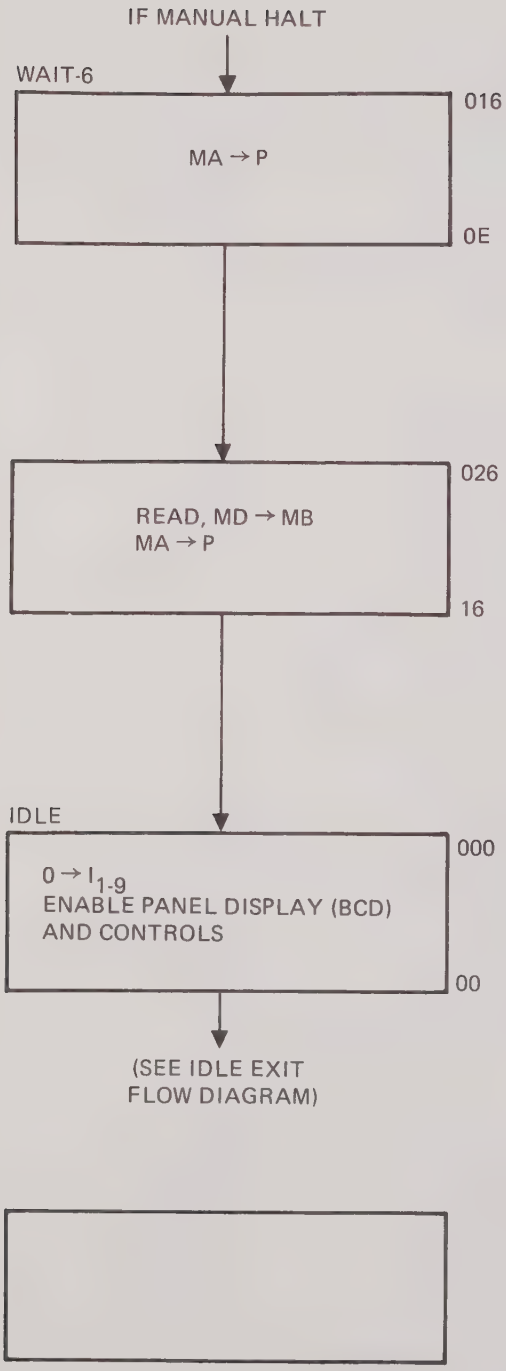
ROM WORD: 0F2F06001B



ADDEND: 000
AUGEND: 00
ALU: 10101
SUM BUS: 110
DATA SET: 011
A SET: 11
B SET 11

G SET: 0
CI: 00
CO: 00
MEM: 11
SPEC: SP0A
TEST: 0000
NEXT: A5

ROM WORD: 0571F06A0A5



ADDEND: 001
AUGEND: 00
ALU: 11111
SUM BUS: 110
DATA SET: 001
A SET: 11
B SET: 11

G SET: 0
CI: 00
CO: 00
MEM: 11
SPEC: 00000
TEST: 0000
NEXT: 16

ROM WORD: 27F1F060016

ADDEND: 000
AUGEND: 00
ALU: 11111
SUM BUS: 110
DATA SET: 010
A SET: 11
B SET: 11

G SET: 0
CI: 00
CO: 00
MEM: 10
SPEC: 00000
TEST: 0000
NEXT: 00

ROM WORD: 07F2F040000

ADDEND: 000
AUGEND: 00
ALU: 00000
SUM BUS: 000
DATA SET: 000
A SET: 11
B SET: 11

G SET: 0
CI: 00
CO: 00
MEM: 11
SPEC: SP01
TEST: BCD
NEXT: 0F

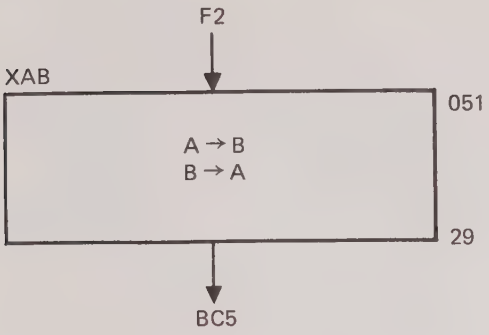
ROM WORD: 0000F061D0F

ADDEND:
AUGEND:
ALU:
SUM BUS:
DATA SET:
A SET:
B SET

G SET:
CI:
CO:
MEM:
SPEC:
TEST:
NEXT:

ROM WORD:

011 XAB EXCHANGE A AND B

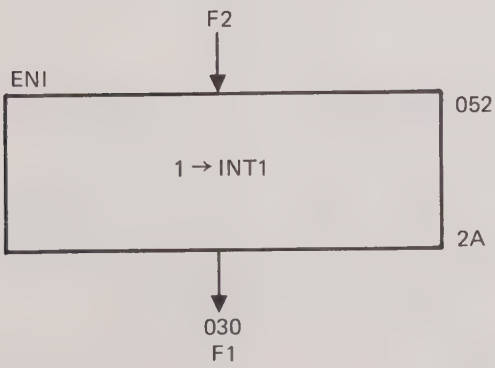


ADDEND: 000
AUGEND: 00
ALU: 00000
SUM BUS: 000
DATA SET: 000
A SET: 10
B SET: 10

G SET: 0
CI: 00
CO: 00
MEM: 11
SPEC: 0000
TEST: BC5
NEXT: 1F

ROM WORD: 0000A06051F

012 ENI ENABLE INTERRUPT SYSTEM

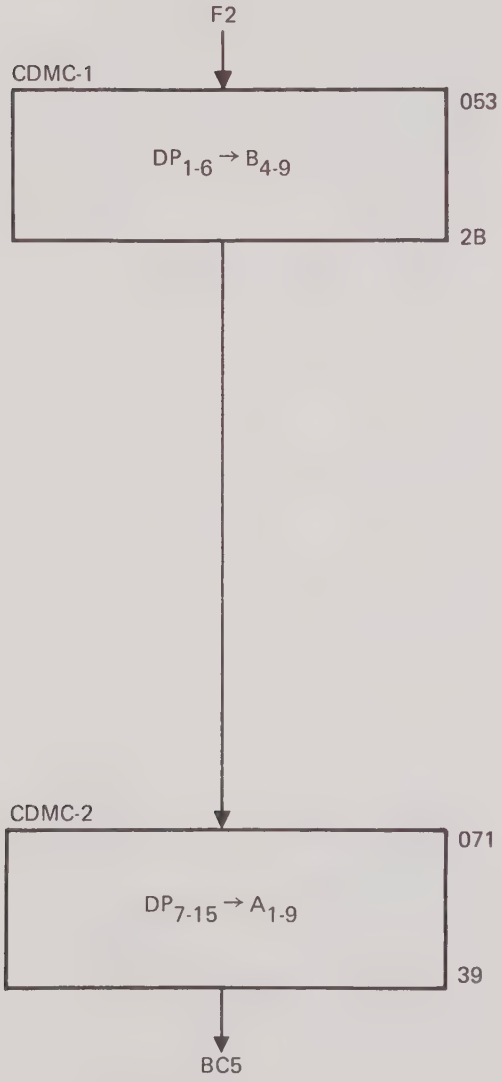


ADDEND: 000
AUGEND: 00
ALU: 00000
SUM BUS: 000
DATA SET: 000
A SET: 11
B SET: 11

G SET: 0
CI: 00
CO: 00
MEM: 11
SPEC: SP17
TEST: 0000
NEXT: 18

ROM WORD: 0000F077018

013 CDMC COPY DMC POINTER (DP) INTO AB



ADDEND: 011
AUGEND: 00
ALU: 11111
SUM BUS: 001
DATA SET: 000
A SET: 11
B SET: 01

G SET: 0
CI: 00
CO: 00
MEM: 11
SPEC: SP0F
TEST: 0000
NEXT: 39

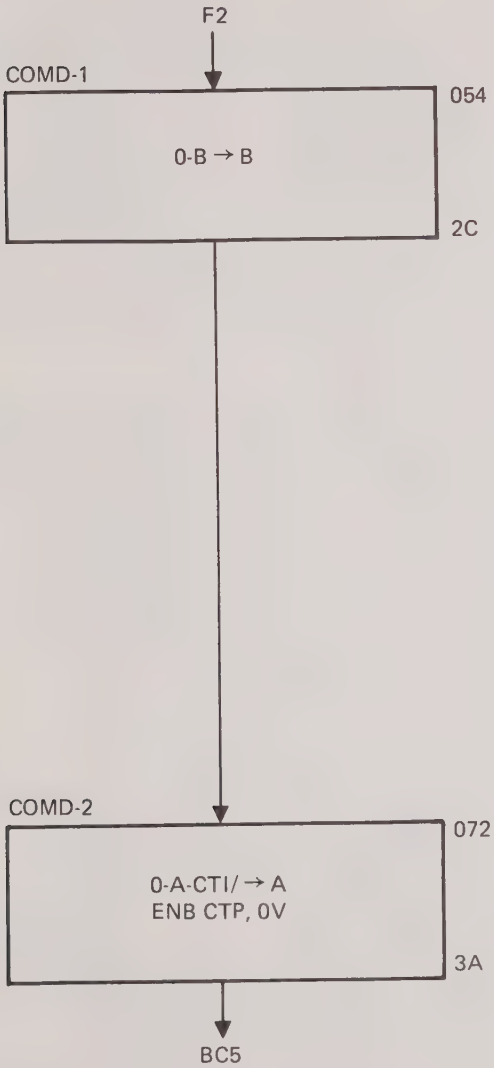
ROM WORD: 67C8D06F039

ADDEND: 011
AUGEND: 00
ALU: 11111
SUM BUS: 010
DATA SET: 000
A SET: 01
B SET: 11

G SET: 0
CI: 00
CO: 00
MEM: 11
SPEC: 00000
TEST: BC5
NEXT: 1F

ROM WORD: 67D0706051F

014 COMD TWO'S COMPLEMENT AB



ADDEND: 000
AUGEND: 11
ALU: 01100
SUM BUS: 110
DATA SET: 000
A SET: 11
B SET: 01

G SET: 0
CI: 01
CO: 00
MEM: 11
SPEC: SP06
TEST: 0000
NEXT: 3A

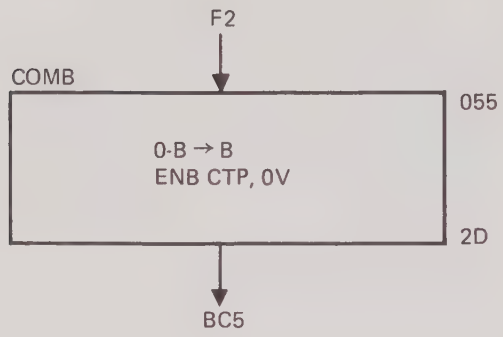
ROM WORD: 1B30D26603A

ADDEND: 000
AUGEND: 10
ALU: 01100
SUM BUS: 110
DATA SET: 000
A SET: 01
B SET: 11

G SET: 0
CI: 11
CO: 01
MEM: 11
SPEC: SP06
TEST: BC5
NEXT: 1F

ROM WORD: 133076E651F

015 COMB TWO'S COMPLEMENT B

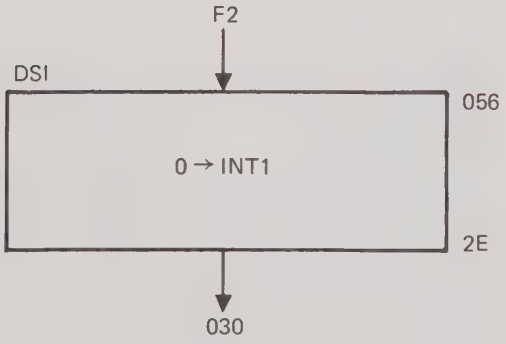


ADDEND: 000
AUGEND: 11
ALU: 01100
SUM BUS: 110
DATA SET: 000
A SET: 11
B SET: 01

G SET: 0
CI: 01
CO: 01
MEM: 11
SPEC: SP06
TEST: BC5
NEXT: 1F

ROM WORD: 1B30D2E651F

016 DSI DISABLE INTERRUPT SYSTEM

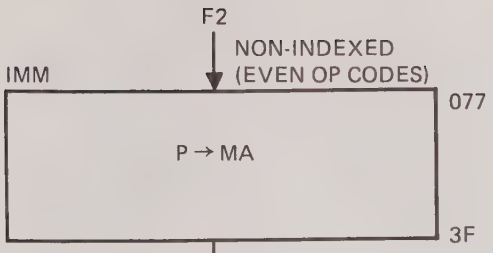


ADDEND: 000
AUGEND: 00
ALU: 00000
SUM BUS: 000
DATA SET: 000
A SET: 11
B SET: 11

G SET: 0
CI: 00
CO: 00
MEM: 11
SPEC: SP0A
TEST: 0000
NEXT: 18

ROM WORD: 0000F06A018

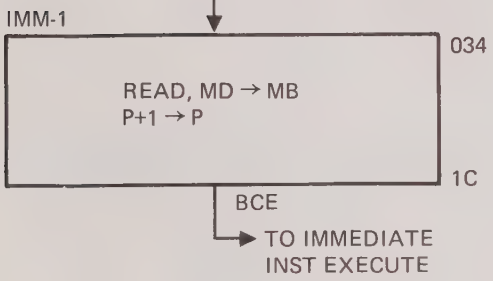
COMMON OPERATION, IMMEDIATE INSTRUCTIONS



ADDEND: 001
AUGEND: 00
ALU: 11111
SUM BUS: 110
DATA SET: 001
A SET: 11
B SET: 11

G SET: 0
CI: 00
CO: 00
MEM: 11
SPEC: 00000
TEST: 0000
NEXT: 1C

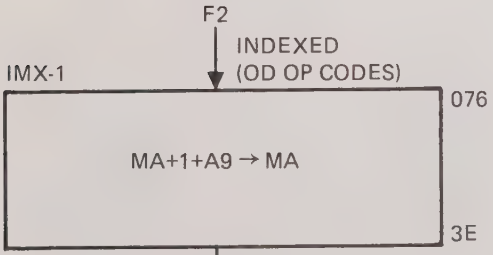
ROM WORD: 27F1F06001C



ADDEND: 001
AUGEND: 00
ALU: 00000
SUM BUS: 110
DATA SET: 010
A SET: 11
B SET: 11

G SET: 0
CI: 01
CO: 00
MEM: 10
SPEC: 00000
TEST: BCE
NEXT: 37

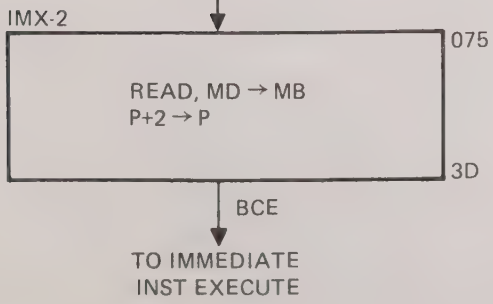
ROM WORD: 2032F240E37



ADDEND: 000
AUGEND: 00
ALU: 10010
SUM BUS: 110
DATA SET: 001
A SET: 11
B SET: 11

G SET: 0
CI: 01
CO: 00
MEM: 11
SPEC: SP0B
TEST: 0000
NEXT: 3D

ROM WORD: 04B1F26B03D

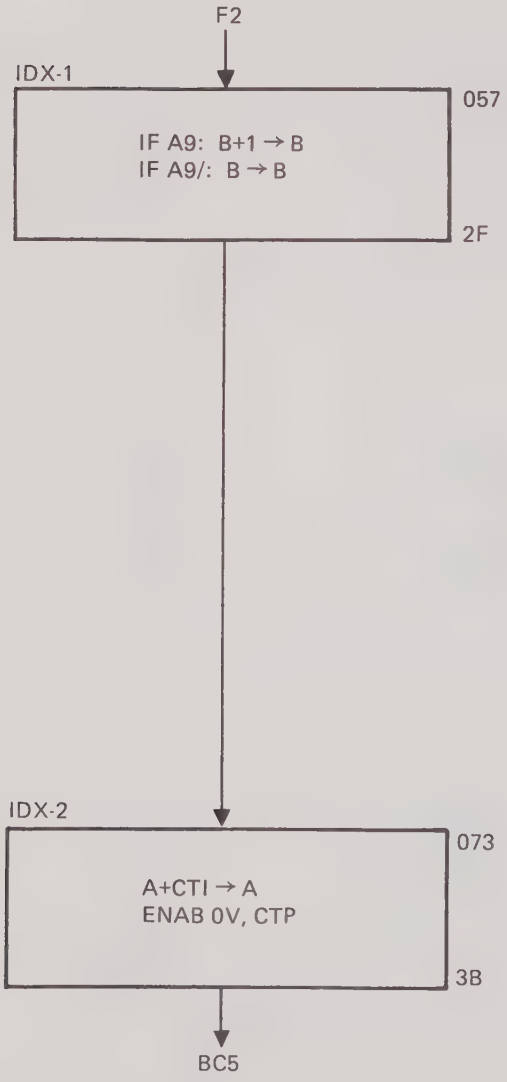


ADDEND: 001
AUGEND: 00
ALU: 10010
SUM BUS: 110
DATA SET: 010
A SET: 11
B SET 11

G SET: 0
CI: 00
CO: 00
MEM: 10
SPEC: SP0C
TEST: BCE
NEXT: 37

ROM WORD: 24B2F04CE37

017 IDX INCREMENT DOUBLE (AB), INDEXED



ADDEND: 111
AUGEND: 00
ALU: 10010
SUM BUS: 110
DATA SET: 000
A SET: 11
B SET: 01

G SET: 0
CI: 00
CO: 00
MEM: 11
SPEC: SP0B
TEST: 0000
NEXT: 3B

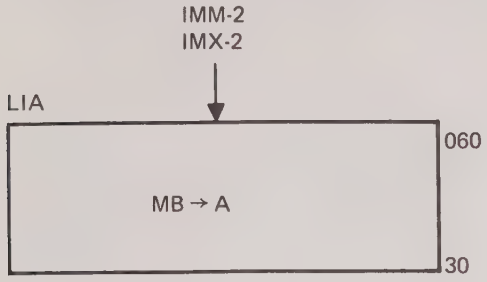
ROM WORD: E4B0D06B03B

ADDEND: 110
AUGEND: 10
ALU: 00000
SUM BUS: 110
DATA SET: 000
A SET: 01
B SET: 11

G SET: 0
CI: 11
CO: 01
MEM: 11
SPEC: 00000
TEST: BC5
NEXT: 1F

ROM WORD: D03076E051F

020 LIA LOAD IMMEDIATE TO A
021 LIAX LOAD IMMEDIATE TO A, INDEXED

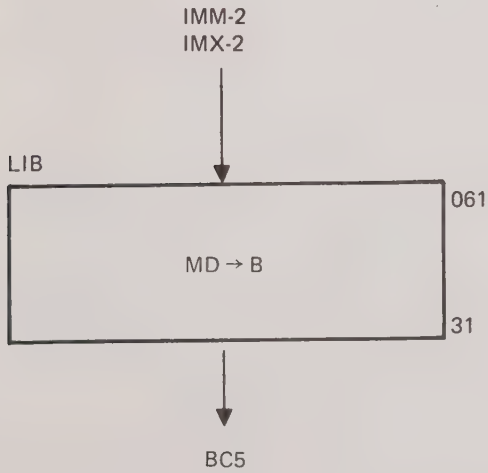


ADDEND: 100
AUGEND: 00
ALU: 11111
SUM BUS: 110
DATA SET: 00
A SET: 01
B SET: 11

G SET: 0
CI: 00
CO: 00
MEM: 11
SPEC: 0000
TEST: BC5
NEXT: 1F

ROM WORD: 87F0706051F

022 LIB LOAD IMMEDIATE TO B
023 LIBX LOAD IMMEDIATE TO B, INDEXED

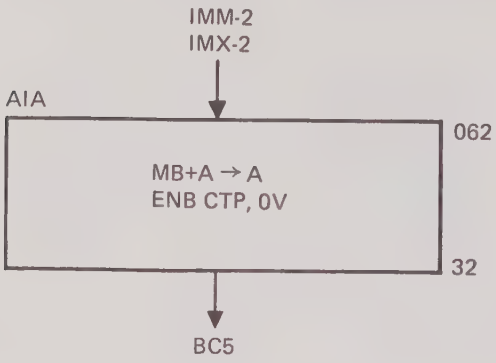


ADDEND: 100
AUGEND: 00
ALU: 11111
SUM BUS: 110
DATA SET: 000
A SET: 11
B SET: 01

G SET: 0
CI: 00
CO: 00
MEM: 11
SPEC: 00000
TEST: BC5
NEXT: 1F

ROM WORD: 87F0D06051F

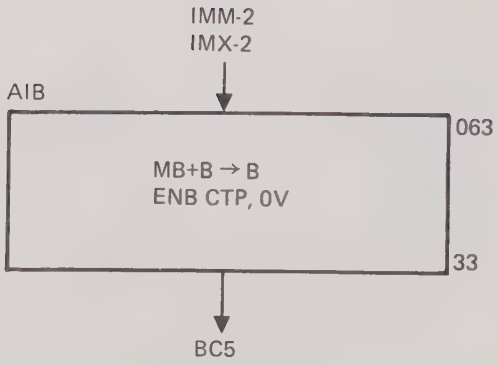
024 AIA ADD IMMEDIATE TO A
025 AIAX ADD IMMEDIATE TO A INDEXED



ADDEND: 110
AUGEND: 00
ALU: 10010
SUM BUS: 110
DATA SET: 000
A SET: 01
B SET: 11

G SET: 0
CI: 00
CO: 01
MEM: 11
SPEC: 00000
TEST: BC5
NEXT: 1F

ROM WORD: C4B070E051F

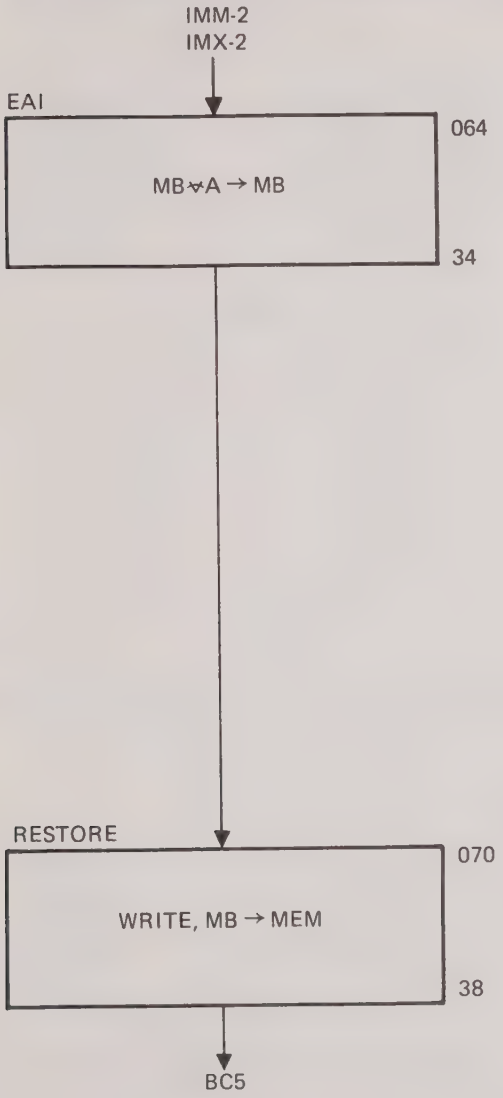


ADDEND: 111
AUGEND: 00
ALU: 10010
SUM BUS: 110
DATA SET: 000
A SET: 11
B SET: 01

G SET: 0
CI: 00
CO: 01
MEM: 11
SPEC: 00000
TEST: BC5
NEXT: 1F

ROM WORD: E4B0D0E051F

030 EAI EXCLUSIVE-OR A TO IMMEDIATE
031 EAIX EXCLUSIVE-OR A TO IMMEDIATE, INDEXED



ADDEND: 110
AUGEND: 00
ALU: 01101
SUM BUS: 110
DATA SET: 101
A SET: 11
B SET: 11

G SET: 0
CI: 00
CO: 00
MEM: 11
SPEC: 00000
TEST: 0000
NEXT: 38

ROM WORD: C375F060038

ADDEND: 000
AUGEND: 00
ALU: 00000
SUM BUS: 000
DATA SET: 000
A SET: 11
B SET: 11

G SET: 0
CI: 00
CO: 00
MEM: 01
SPEC: 00000
TEST: BC5
NEXT: 1F

ROM WORD: 0000F02051F

032 EBI EXCLUSIVE-OR B TO IMMEDIATE
033 EBIX EXCLUSIVE-OR B TO IMMEDIATE, INDEXED

ADDEND: 111
AUGEND: 00
ALU: 01101
SUM BUS: 110
DATA SET: 101
A SET: 11
B SET: 11

G SET: 0
CI: 00
CO: 00
MEM: 11
SPEC: 00000
TEST: 0000
NEXT: 38

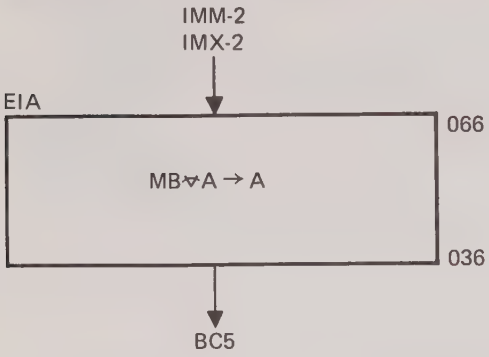
ROM WORD: E375F060038

ADDEND: 000
AUGEND: 00
ALU: 00000
SUM BUS: 000
DATA SET: 000
A SET: 11
B SET: 11

G SET: 0
CI: 00
CO: 00
MEM: 01
SPEC: 00000
TEST: BC5
NEXT: 1F

ROM WORD: 0000F02051F

034 EIA EXCLUSIVE-OR IMMEDIATE TO A
035 EIAX EXCLUSIVE-OR IMMEDIATE TO A, INDEXED

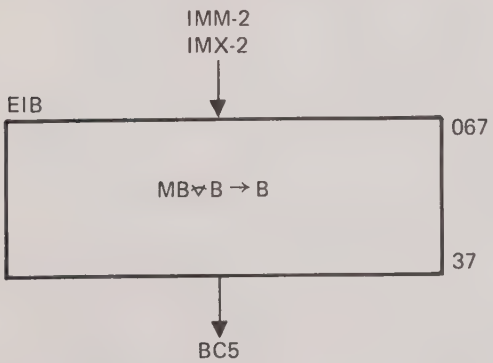


ADDEND: 110
AUGEND: 00
ALU: 01101
SUM BUS: 110
DATA SET: 000
A SET: 01
B SET: 11

G SET: 0
CI: 00
CO: 00
MEM: 11
SPEC: 00000
TEST: BC5
NEXT: 1F

ROM WORD: C370706051F

036 EIB EXCLUSIVE-OR IMMEDIATE TO B
037 EIBX EXCLUSIVE-OR IMMEDIATE TO B, INDEXED

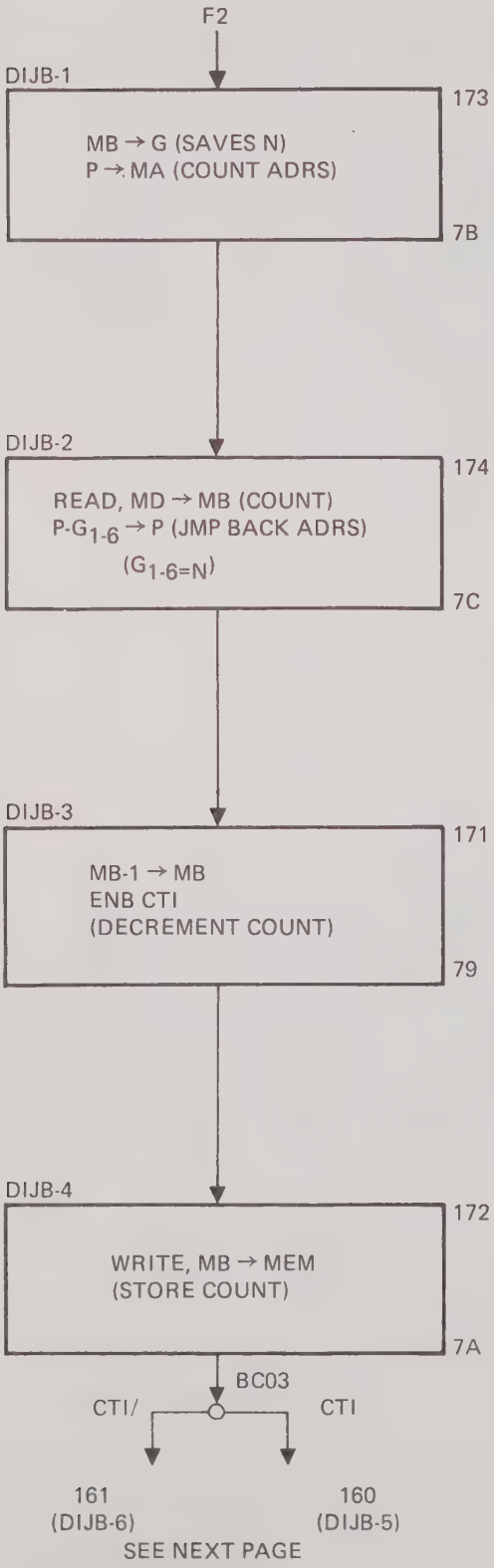


ADDEND: 111
AUGEND: 00
ALU: 01101
SUM BUS: 110
DATA SET: 000
A SET: 11
B SET: 01

G SET: 0
CI: 00
CO: 00
MEM: 11
SPEC: 00000
TEST: BC5
NEXT: 1F

ROM WORD: E370D06051F

0001N DIJB DECREMENT IMMEDIATE ONE, JUMP BACK N LOCATIONS IF NO OVERFLOW



ADDEND: 001
AUGEND: 00
ALU: 11111
SUM BUS: 110
DATA SET: 001
A SET: 11
B SET: 11

G SET: 1
CI: 00
CO: 00
MEM: 11
SPEC: 00000
TEST: 0000
NEXT: 7C

ROM WORD: 271F1F86007C

ADDEND: 001
AUGEND: 01
ALU: 01100
SUM BUS: 110
DATA SET: 010
A SET: 11
B SET: 11

G SET: 0
CI: 00
CO: 00
MEM: 10
SPEC: 01001
TEST: 00000
NEXT: 79

ROM WORD: 2B32F049079

ADDEND: 100
AUGEND: 00
ALU: 11110
SUM BUS: 110
DATA SET: 101
A SET: 11
B SET: 11

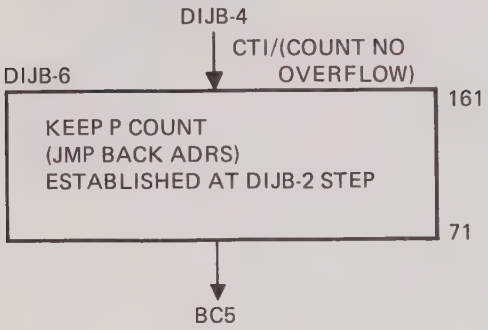
G SET: 0
CI: 00
CO: 00
MEM: 11
SPEC: SPD
TEST: 0000
NEXT: 7A

ROM WORD: 87B5F06D07A

ADDEND: 000
AUGEND: 00
ALU: 00000
SUM BUS: 000
DATA SET: 000
A SET: 11
B SET 11

G SET: 0
CI: 00
CO: 00
MEM: 01
SPEC: 00000
TEST: BC3
NEXT: 71

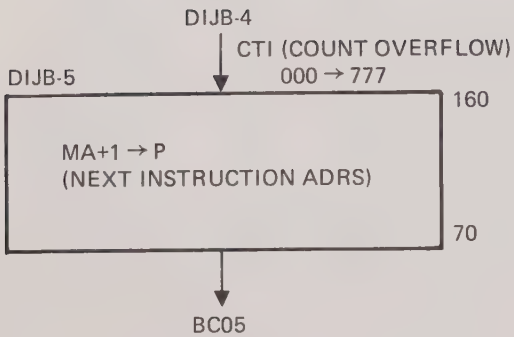
ROM WORD: 0000F020371



ADDEND: 000
AUGEND: 00
ALU: 00000
SUM BUS: 000
DATA SET: 00
A SET: 11
B SET: 11

G SET: 0
CI: 00
CO: 00
MEM: 11
SPEC: 00000
TEST: BC5
NEXT: 1F

ROM WORD: 0000F06051F

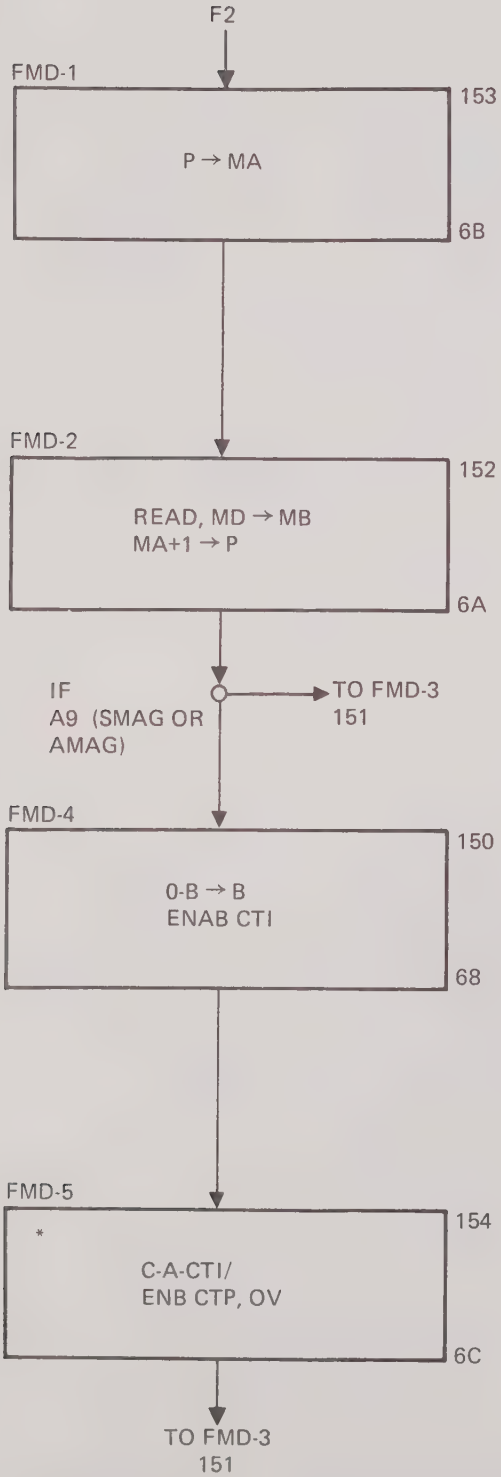


ADDEND: 000
AUGEND: 00
ALU: 00000
SUM BUS: 110
DATA SET: 010
A SET: 11
B SET: 11

G SET: 0
CI: 01
CO: 00
MEM: 11
SPEC: 00000
TEST: BC5
NEXT: 1F

ROM WORD: 0032F26051F

COMMON OPERATION, IPXD INSTRUCITONS



ADDEND: 001
AUGEND: 00
ALU: 11111
SUM BUS: 110
DATA SET: 01
A SET: 11
B SET: 11

G SET: 0
CI: 00
CO: 00
MEM: 11
SPEC: 00000
TEST: 0000
NEXT: 6A

ROM WORD: 27F1F06006A

ADDEND: 000
AUGEND: 00
ALU: 00000
SUM BUS: 110
DATA SET: 010
A SET: 11
B SET: 11

G SET: 0
CI: 01
CO: 00
MEM: 10
SPEC: 00000
TEST: BC2
NEXT: 69

ROM WORD: 0032F240269

ADDEND: 000
AUGEND: 11
ALU: 01100
SUM BUS: 110
DATA SET: 000
A SET: 11
B SET: 01

G SET: 0
CI: 01
CO: 00
MEM: 11
SPEC: SP06
TEST: 0000
NEXT: 6C

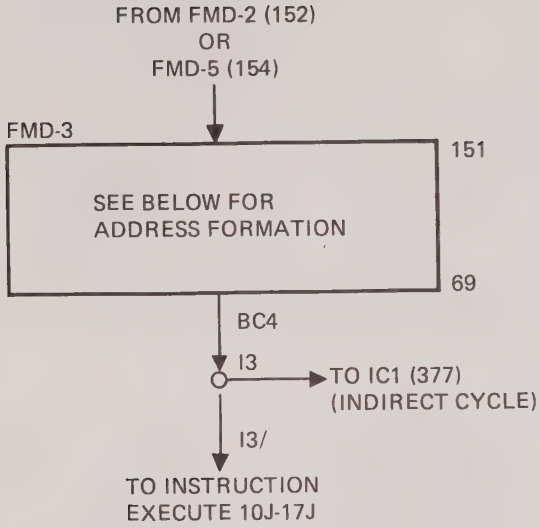
ROM WORD: 1B30D26606C

ADDEND: 000
AUGEND: 10
ALU: 01100
SUM BUS: 110
DATA SET: 000
A SET: 01
B SET 11

G SET: 0
CI: 11
CO: 10
MEM: 11
SPEC: SP06
TEST: 0000
NEXT: 69

ROM WORD: 13307766069

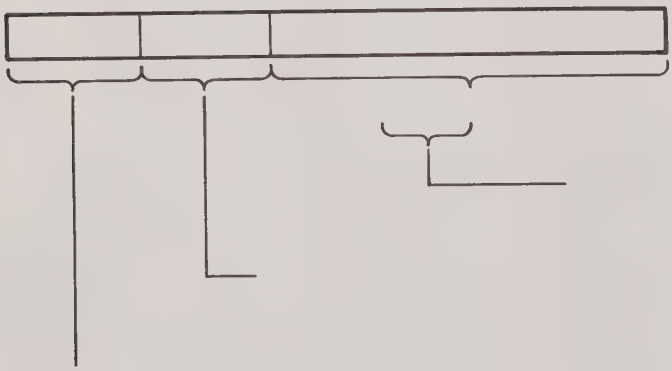
*GETS POSITIVE VALUE OF AB IF AB IS NEGATIVE FOR AMAG OR SMAG INST.



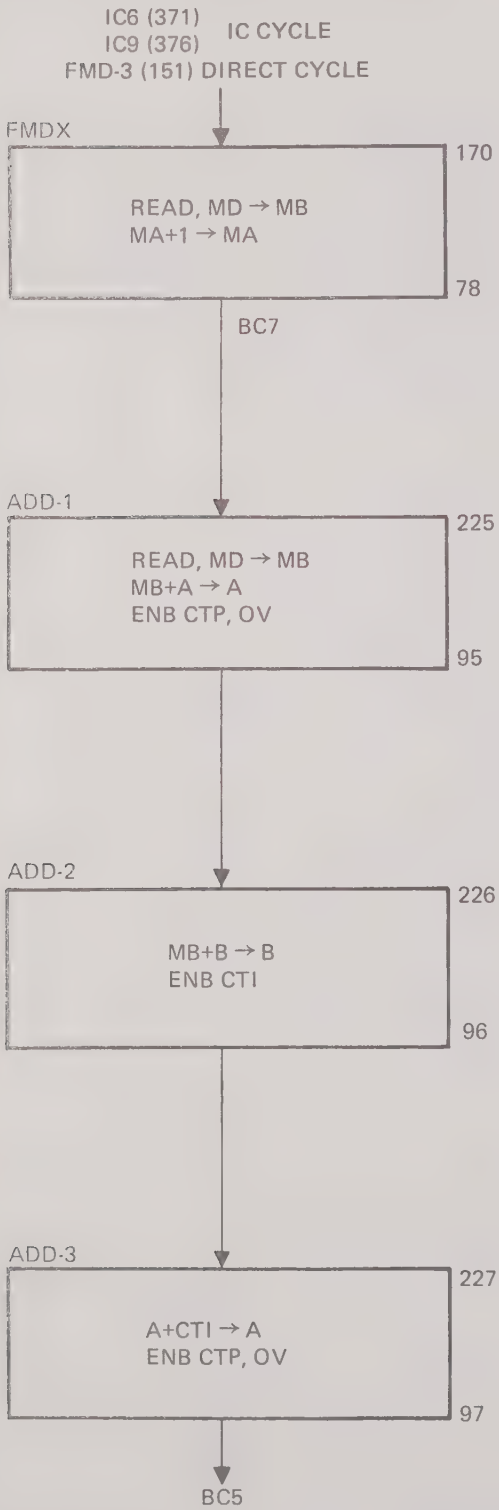
ADDEND: 110
AUGEND: 00
ALU: 10010
SUM BUS: 111
DATA SET: 001
A SET: 11
B SET: 11

G SET: 0
CI: 00
CO: 00
MEM: 11
SPEC: SP05
TEST: BC4
NEXT: FF

ROM WORD: 8489F0654FF



10J ADD ADD MEMORY DOUBLE TO AB



ADDEND: 000
AUGEND: 00
ALU: 00000
SUM BUS: 110
DATA SET: 001
A SET: 11
B SET: 11

G SET: 0
CI: 01
CO: 00
MEM: 10
SPEC: 00000
TEST: BC7
NEXT: FF

ROM WORD: 0031F2407FF

ADDEND: 110
AUGEND: 00
ALU: 10010
SUM BUS: 110
DATA SET: 000
A SET: 01
B SET: 11

G SET: 0
CI: 00
CO: 01
MEM: 10
SPEC: 00000
TEST: 0000
NEXT: 96

ROM WORD: C4B070C0096

ADDEND: 111
AUGEND: 00
ALU: 10010
SUM BUS: 110
DATA SET: 00
A SET: 11
B SET: 01

G SET: 0
CI: 00
CO: 00
MEM: 11
SPEC: 00000
TEST: 0000
NEXT: 97

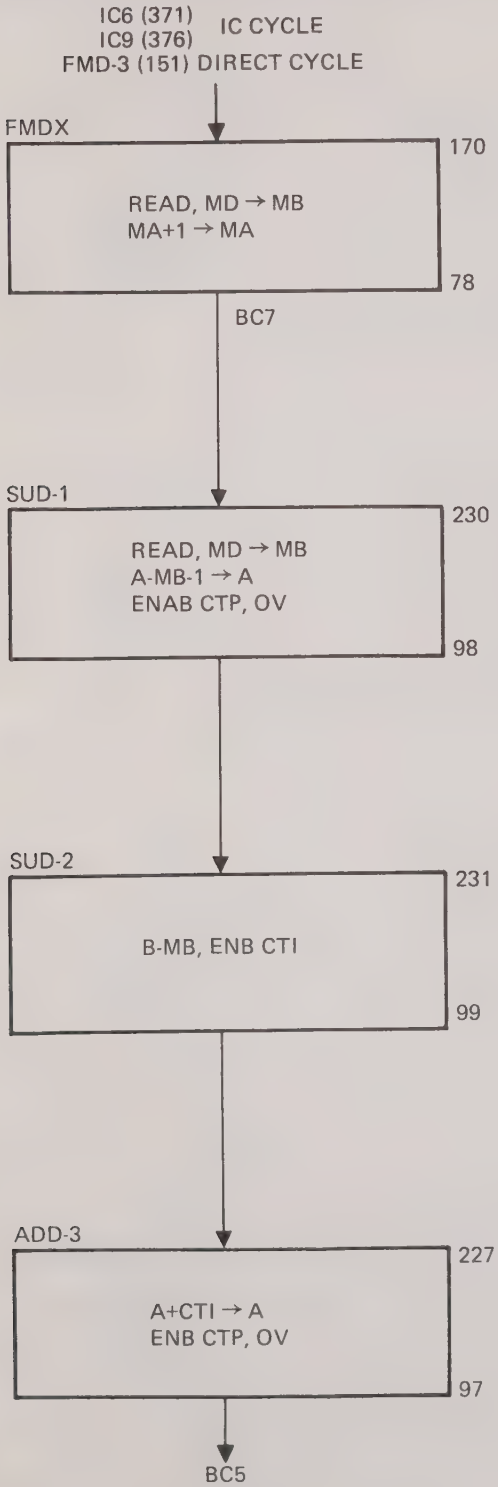
ROM WORD: E4B0D060097

ADDEND: 110
AUGEND: 10
ALU: 00000
SUM BUS: 110
DATA SET: 00
A SET: 01
B SET 11

G SET: 0
CI: 11
CO: 10
MEM: 11
SPEC: SP09
TEST: BC5
NEXT: 1F

ROM WORD: D030776951F

11J SUD SUBTRACT MEMORY DOUBLE FROM AB



ADDEND: 000
AUGEND: 00
ALU: 00000
SUM BUS: 110
DATA SET: 001
A SET: 11
B SET: 11

G SET: 0
CI: 01
CO: 00
MEM: 10
SPEC: 00000
TEST: BC7
NEXT: FF

ROM WORD: 0031F2407FF

ADDEND: 110
AUGEND: 00
ALU: 01100
SUM BUS: 110
DATA SET: 000
A SET: 01
B SET: 11

G SET: 0
CI: 00
CO: 01
MEM: 10
SPEC: 00000
TEST: 0000
NEXT: 99

ROM WORD: C33070C0099

ADDEND: 111
AUGEND: 00
ALU: 01100
SUM BUS: 110
DATA SET: 000
A SET: 11
B SET: 01

G SET: 0
CI: 01
CO: 00
MEM: 11
SPEC: 00000
TEST: 0000
NEXT: 97

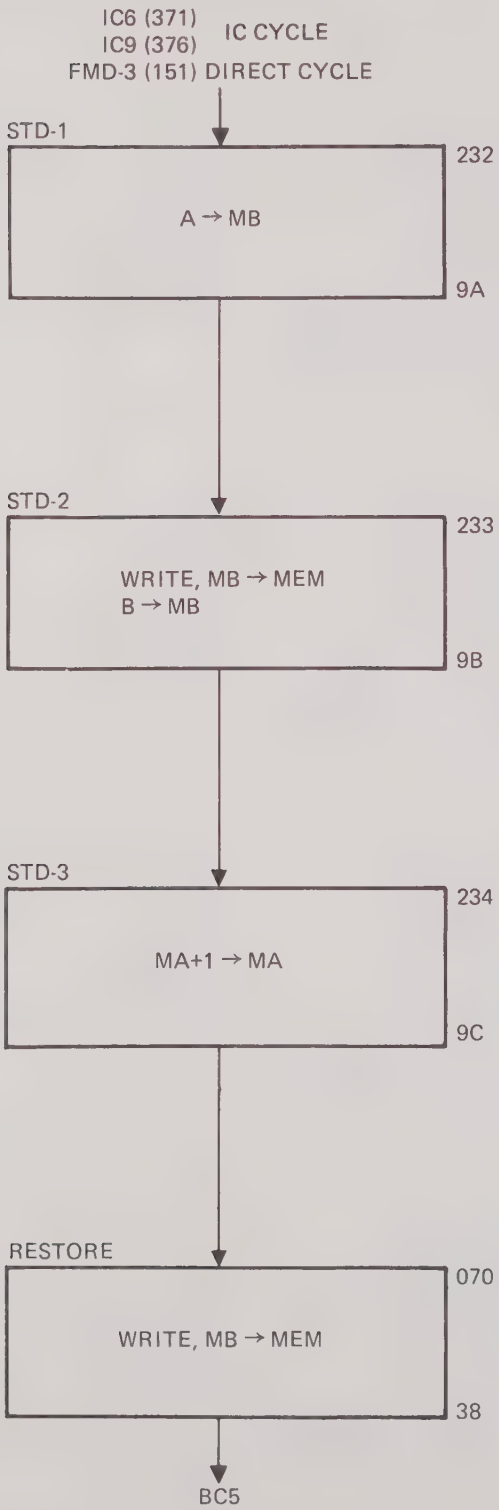
ROM WORD: E0330D260097

ADDEND: 110
AUGEND: 10
ALU: 00000
SUM BUS: 110
DATA SET: 000
A SET: 01
B SET 11

G SET: 0
CI: 11
CO: 10
MEM: 11
SPEC: SP09
TEST: BC5
NEXT: 1F

ROM WORD: D030776951F

12J STD STORE DOUBLE (AB) IN MEMORY



ADDEND: 110
AUGEND: 00
ALU: 11111
SUM BUS: 110
DATA SET: 101
A SET: 11
B SET: 11

G SET: 0
CI: 00
CO: 00
MEM: 11
SPEC: 00000
TEST: 0000
NEXT: 9B

ROM WORD: C7F5F06009B

ADDEND: 111
AUGEND: 00
ALU: 11111
SUM BUS: 110
DATA SET: 101
A SET: 11
B SET: 11

G SET: 0
CI: 00
CO: 00
MEM: 01
SPEC: 00000
TEST: 0000
NEXT: 9C

ROM WORD: E7F5F02009C

ADDEND: 000
AUGEND: 00
ALU: 00000
SUM BUS: 110
DATA SET: 001
A SET: 11
B SET: 11

G SET: 0
CI: 01
CO: 00
MEM: 11
SPEC: 00000
TEST: 0000
NEXT: 38

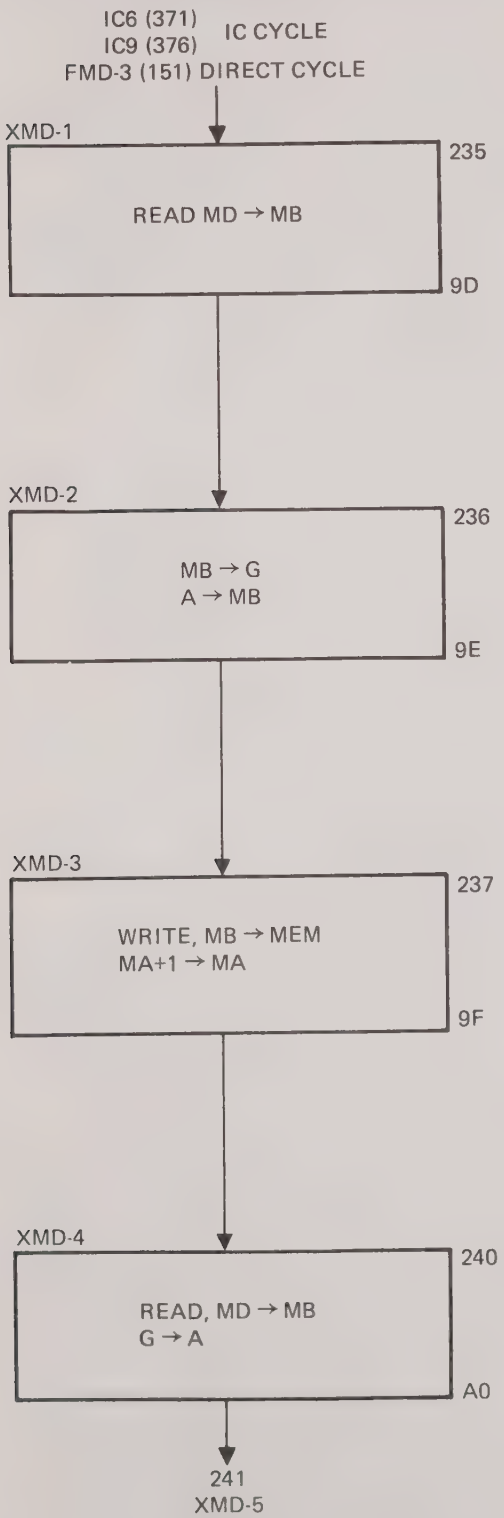
ROM WORD: 0031F260038

ADDEND: 000
AUGEND: 00
ALU: 00000
SUM BUS: 000
DATA SET: 000
A SET: 11
B SET 11

G SET: 0
CI: 00
CO: 00
MEM: 01
SPEC: 00000
TEST: BC5
NEXT: 1F

ROM WORD: 0000F02051F

13J XMD EXCHANGE MEMORY AND AB



ADDEND: 000
AUGEND: 00
ALU: 00000
SUM BUS: 000
DATA SET: 000
A SET: 11
B SET: 11

G SET: 0
CI: 00
CO: 00
MEM: 10
SPEC: 00000
TEST: 0000
NEXT: 9E

ROM WORD: 0000F04009E

ADDEND: 110
AUGEND: 00
ALU: 11111
SUM BUS: 110
DATA SET: 101
A SET: 11
B SET: 11

G SET: 1
CI: 00
CO: 00
MEM: 11
SPEC: 00000
TEST: 0000
NEXT: 9F

ROM WORD: C7F5F86009F

ADDEND: 000
AUGEND: 00
ALU: 00000
SUM BUS: 110
DATA SET: 001
A SET: 11
B SET: 11

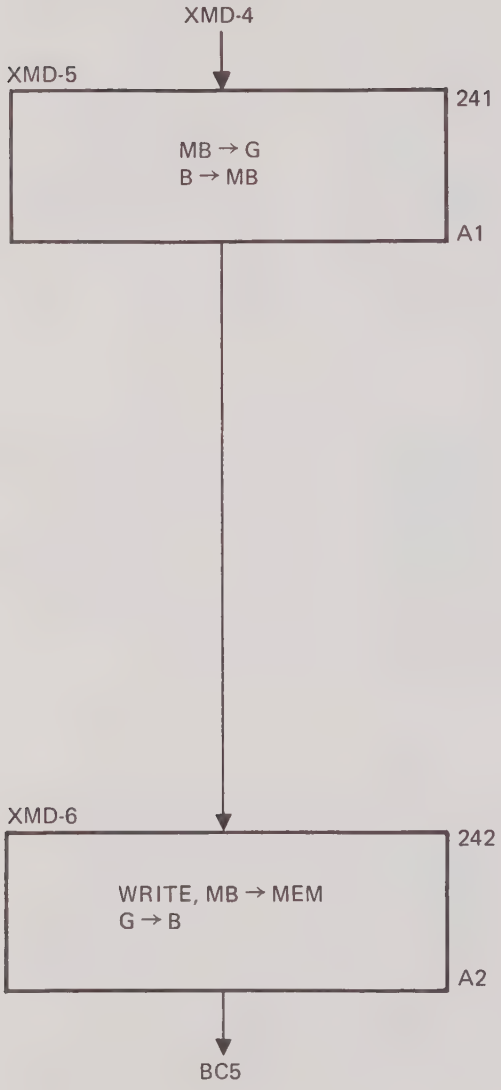
G SET: 0
CI: 01
CO: 00
MEM: 01
SPEC: 00000
TEST: 0000
NEXT: A0

ROM WORD: 0031F2200A0

ADDEND: 000
AUGEND: 01
ALU: 10101
SUM BUS: 110
DATA SET: 000
A SET: 01
B SET 11

G SET: 0
CI: 11
CO: 11
MEM: 10
SPEC: 00000
TEST: 0000
NEXT: A1

ROM WORD: 0D7070400A1



ADDEND: 111
AUGEND: 00
ALU: 11111
SUM BUS: 110
DATA SET: 101
A SET: 11
B SET: 11

G SET: 1
CI: 00
CO: 00
MEM: 11
SPEC: 00000
TEST: 0000
NEXT: A2

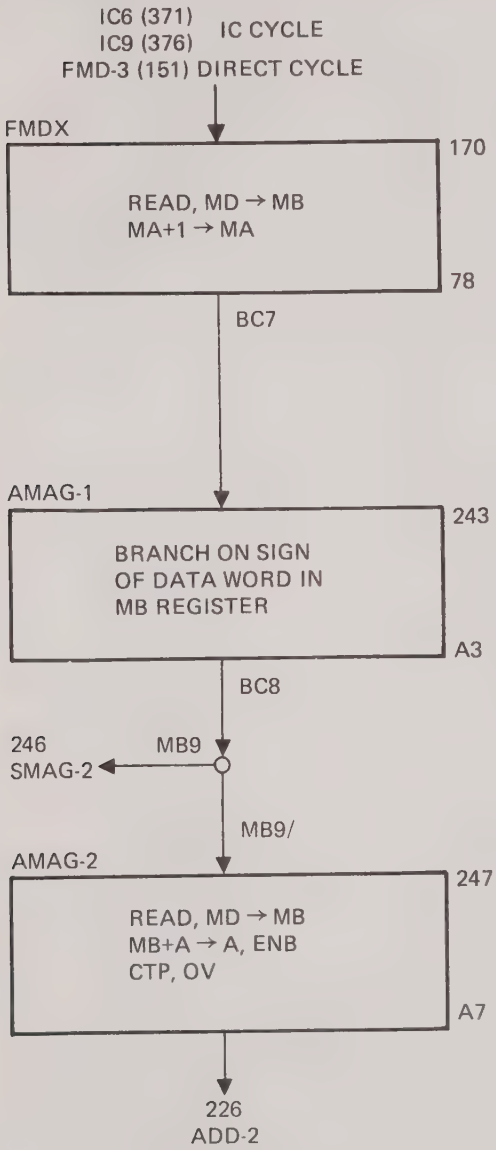
ROM WORD: E7F5F8600A2

ADDEND: 000
AUGEND: 01
ALU: 10101
SUM BUS: 110
DATA SET: 000
A SET: 11
B SET: 01

G SET: 0
CI: 00
CO: 00
MEM: 01
SPEC: 00000
TEST: BC5
NEXT: 1F

ROM WORD: 0D70D02051F

14J AMAG ADD MAGNITUDES OF MEMORY AND AB TO AB



ADDEND: 000
AUGEND: 00
ALU: 00000
SUM BUS: 110
DATA SET: 001
A SET: 11
B SET: 11

G SET: 0
CI: 01
CO: 00
MEM: 10
SPEC: 00000
TEST: BC7
NEXT: FF

ROM WORD: 0031F2407FF

ADDEND: 000
AUGEND: 00
ALU: 00000
SUM BUS: 000
DATA SET: 000
A SET: 11
B SET: 11

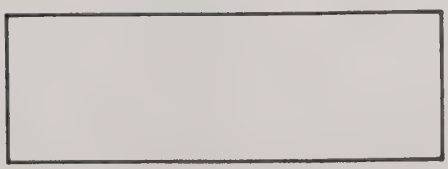
G SET: 0
CI: 00
CO: 00
MEM: 11
SPEC: 00000
TEST: BC8
NEXT: A7

ROM WORD: 0000F0608A7

ADDEND: 110
AUGEND: 00
ALU: 10010
SUM BUS: 110
DATA SET: 000
A SET: 01
B SET: 11

G SET: 0
CI: 00
CO: 01
MEM: 10
SPEC: 00000
TEST: 0000
NEXT: 96

ROM WORD: C4B070C0096

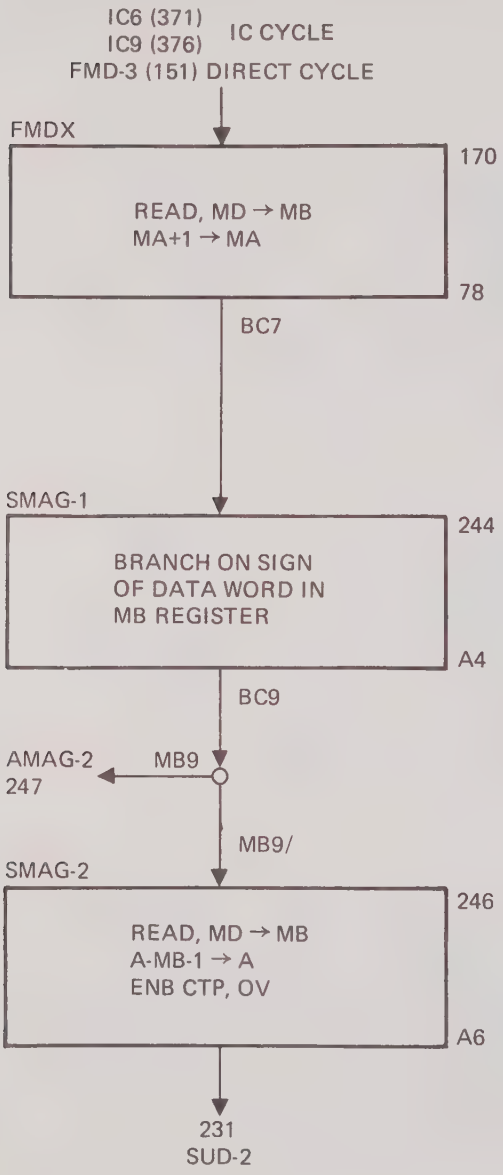


ADDEND:
AUGEND:
ALU:
SUM BUS:
DATA SET:
A SET:
B SET

G SET:
CI:
CO:
MEM:
SPEC:
TEST:
NEXT:

ROM WORD:

15J SMAG SUBTRACT MAGNITUDES OF MEMORY AND AB TO AB



ADDEND: 000
AUGEND: 00
ALU: 00000
SUM BUS: 110
DATA SET: 001
A SET: 11
B SET: 11

G SET: 0
CI: 01
CO: 00
MEM: 10
SPEC: 00000
TEST: BC7
NEXT: FF

ROM WORD: 0031F2407FF

ADDEND: 000
AUGEND: 00
ALU: 00000
SUM BUS: 000
DATA SET: 000
A SET: 11
B SET: 11

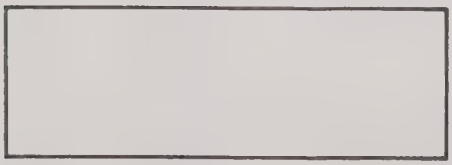
G SET: 0
CI: 00
CO: 00
MEM: 11
SPEC: 00000
TEST: BC9
NEXT: A7

ROM WORD: 0000F0609A7

ADDEND: 110
AUGEND: 00
ALU: 01100
SUM BUS: 110
DATA SET: 000
A SET: 01
B SET: 11

G SET: 0
CI: 00
CO: 01
MEM: 10
SPEC: 00000
TEST: 0000
NEXT: 99

ROM WORD: C33070C0099

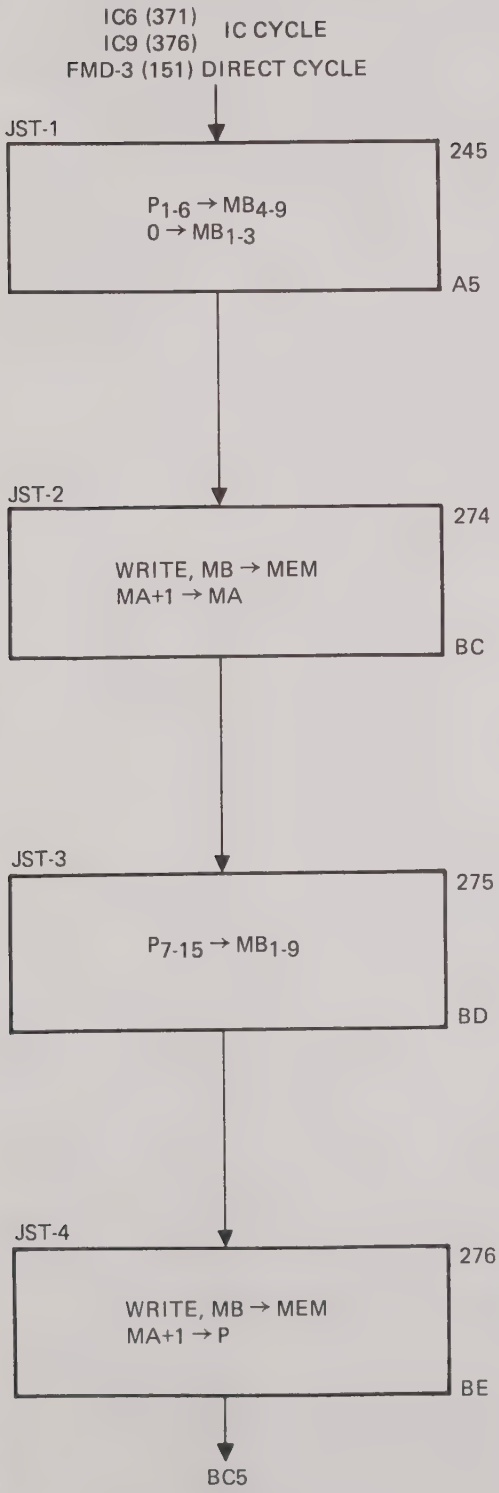


ADDEND:
AUGEND:
ALU:
SUM BUS:
DATA SET:
A SET:
B SET

G SET:
CI:
CO:
MEM:
SPEC:
TEST:
NEXT:

ROM WORD:

16J JST JUMP STORE



ADDEND: 001
AUGEND: 000
ALU: 11111
SUM BUS: 001
DATA SET: 101
A SET: 11
B SET: 11

G SET: 0
CI: 00
CO: 00
MEM: 11
SPEC: SP0E
TEST: 0000
NEXT: BC

ROM WORD: 27CDF06E0BC

ADDEND: 000
AUGEND: 00
ALU: 00000
SUM BUS: 110
DATA SET: 001
A SET: 11
B SET: 11

G SET: 0
CI: 01
CO: 00
MEM: 01
SPEC: 00000
TEST: 0000
NEXT: BD

ROM WORD: 0031F2200BD

ADDEND: 001
AUGEND: 00
ALU: 11111
SUM BUS: 010
DATA SET: 101
A SET: 11
B SET: 11

G SET: 0
CI: 00
CO: 00
MEM: 11
SPEC: 00000
TEST: 0000
NEXT: BE

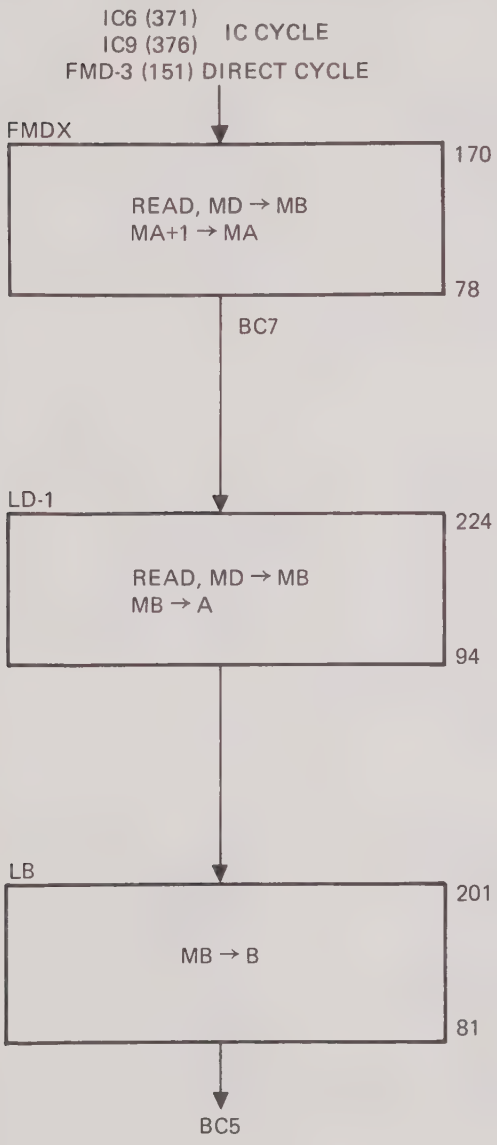
ROM WORD: 27D5F0600BE

ADDEND: 000
AUGEND: 00
ALU: 00000
SUM BUS: 110
DATA SET: 010
A SET: 11
B SET 11

G SET: 0
CI: 01
CO: 00
MEM: 01
SPEC: 0000
TEST: BC5
NEXT: 1F

ROM WORD: 0032F22051F

17J LD LOAD DOUBLE (AB) FROM MEMORY



ADDEND: 000
AUGEND: 00
ALU: 00000
SUM BUS: 110
DATA SET: 001
A SET: 11
B SET: 11

G SET: 0
CI: 01
CO: 00
MEM: 10
SPEC: 00000
TEST: BC7
NEXT: FF

ROM WORD: 0031F2407FF

ADDEND: 000
AUGEND: 00
ALU: 10101
SUM BUS: 110
DATA SET: 000
A SET: 01
B SET: 11

G SET: 0
CI: 00
CO: 00
MEM: 10
SPEC: 00000
TEST: 0000
NEXT: 81

ROM WORD: 05707040081

ADDEND: 100
AUGEND: 00
ALU: 11111
SUM BUS: 110
DATA SET: 000
A SET: 11
B SET: 01

G SET: 0
CI: 00
CO: 00
MEM: 11
SPEC: 00000
TEST: BC5
NEXT: 1F

ROM WORD: 87F0D06051F

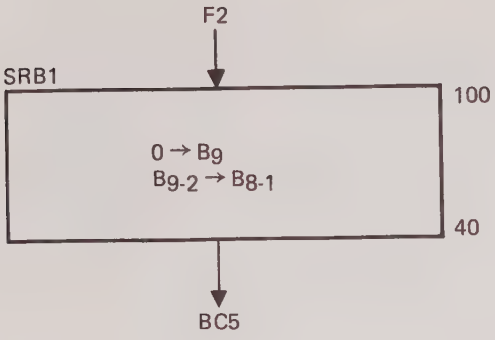
ADDEND:
AUGEND:
ALU:
SUM BUS:
DATA SET:
A SET:
B SET

G SET:
CI:
CO:
MEM:
SPEC:
TEST:
NEXT:

ROM WORD:

5E6

200 SRB1 SHIFT RIGHT B ONE BIT

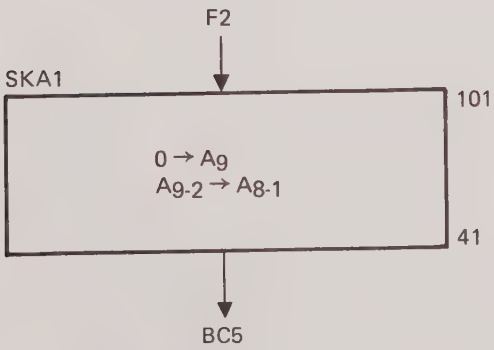


ADDEND: 111
AUGEND: 00
ALU: 11111
SUM BUS: 101
DATA SET: 000
A SET: 11
B SET: 01

G SET: 0
CI: 00
CO: 00
MEM: 11
SPEC: SP0F
TEST: BC5
NEXT: 1F

ROM WORD: E7E8D06F51F

201 SRA1 SHIFT RIGHT A ONE BIT

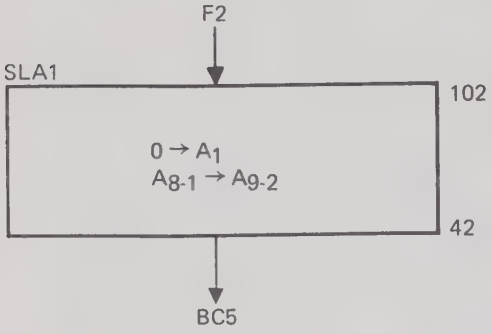


ADDEND: 110
AUGEND: 00
ALU: 11111
SUM BUS: 101
DATA SET: 000
A SET: 01
B SET: 11

G SET: 0
CI: 00
CO: 00
MEM: 11
SPEC: SP0F
TEST: BC5
NEXT: 1F

ROM WORD: C7E8706F51F

202 SLA1 SHIFT LEFT A ONE BIT

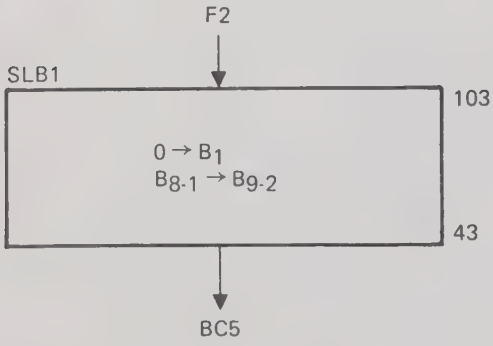


ADDEND: 110
AUGEND: 00
ALU: 11111
SUM BUS: 100
DATA SET: 000
A SET: 01
B SET: 11

G SET: 0
CI: 00
CO: 00
MEM: 11
SPEC: SP0F
TEST: BC5
NEXT: 1F

ROM WORD: C7E0706F51F

203 SLB1 SHIFT LEFT B ONE BIT

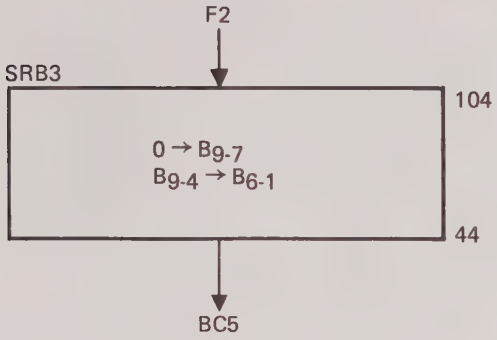


ADDEND: 111
AUGEND: 000
ALU: 11111
SUM BUS: 100
DATA SET: 000
A SET: 11
B SET: 01

G SET: 0
CI: 00
CO: 00
MEM: 11
SPEC: SP0F
TEST: BC5
NEXT: 1F

ROM WORD: E7E0D06F51F

204 SKB3 SHIFT RIGHT B THREE BITS

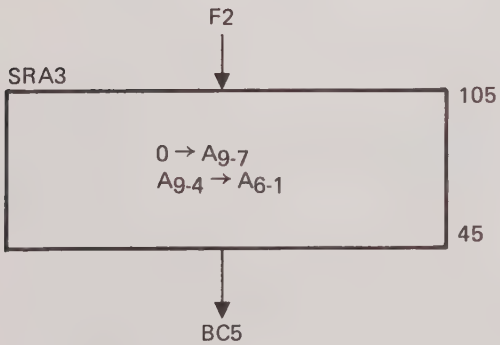


ADDEND: 111
AUGEND: 00
ALU: 11111
SUM BUS: 011
DATA SET: 000
A SET: 11
B SET: 01

G SET: 0
CI: 00
CO: 00
MEM: 11
SPEC: SP0F
TEST: BC5
NEXT: 1F

ROM WORD: E7D8D06F51F

205 SRA3 SHIFT RIGHT A THREE BITS

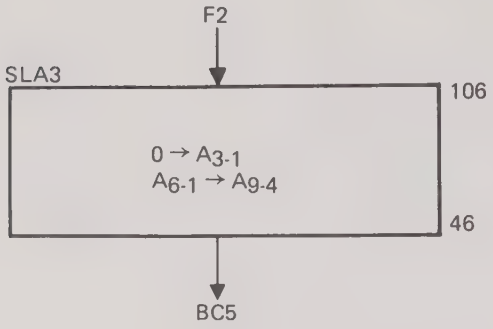


ADDEND: 110
AUGEND: 00
ALU: 11111
SUM BUS: 011
DATA SET: 000
A SET: 01
B SET: 11

G SET: 0
CI: 00
CO: 00
MEM: 11
SPEC: SP0F
TEST: BC5
NEXT: 1F

ROM WORD: C7D8706F51F

206 SLA3 SHIFT LEFT A THREE BITS

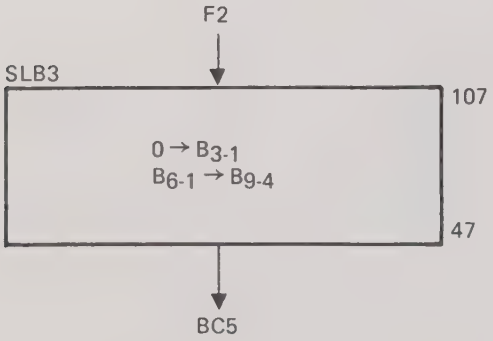


ADDEND: 110
AUGEND: 00
ALU: 11111
SUM BUS: 001
DATA SET: 000
A SET: 01
B SET: 11

G SET: 0
CI: 00
CO: 00
MEM: 11
SPEC: SP0F
TEST: BC5
NEXT: 1F

ROM WORD: C7C8706F51F

207 SLB3 SHIFT LEFT B THREE BITS

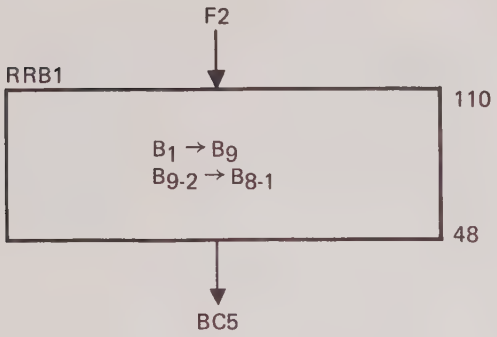


ADDEND: 111
AUGEND: 00
ALU: 11111
SUM BUS: 001
DATA SET: 000
A SET: 11
B SET: 01

G SET: 0
CI: 00
CO: 00
MEM: 11
SPEC: SP0F
TEST: BC5
NEXT: 1F

ROM WORD: E7C8D06F51F

210 RRB1 ROTATE RIGHT B ONE BIT

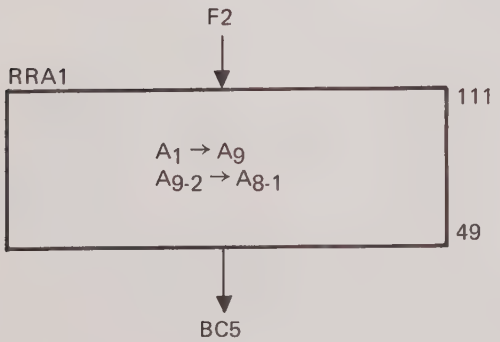


ADDEND: 111
AUGEND: 00
ALU: 11111
SUM BUS: 101
DATA SET: 000
A SET: 11
B SET: 01

G SET: 0
CI: 00
CO: 00
MEM: 11
SPEC: 00000
TEST: BC5
NEXT: 1F

ROM WORD: E7E8D06051F

211 RRA1 ROTATE RIGHT A ONE BIT

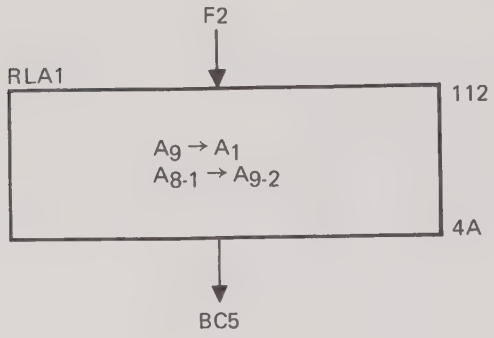


ADDEND: 110
AUGEND: 00
ALU: 11111
SUM BUS: 101
DATA SET: 000
A SET: 01
B SET: 11

G SET: 0
CI: 00
CO: 00
MEM: 11
SPEC: 00000
TEST: 0101
NEXT: 1F

ROM WORD: C7E8706051F

212 RLA1 ROTATE LEFT A ONE BIT

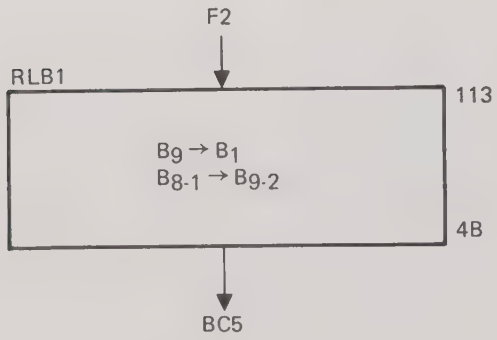


ADDEND: 110
AUGEND: 00
ALU: 11111
SUM BUS: 100
DATA SET: 000
A SET: 01
B SET: 11

G SET: 0
CI: 00
CO: 00
MEM: 11
SPEC: 00000
TEST: BC5
NEXT: 1F

ROM WORD: C7E0706051F

213 RLB1 ROTATE LEFT B ONE BIT

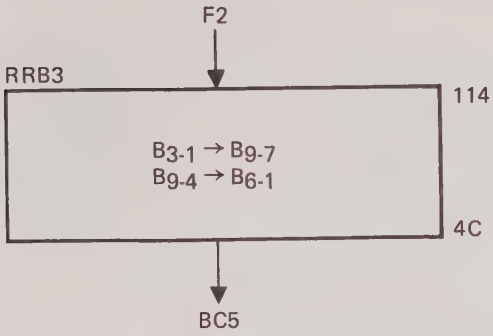


ADDEND: 111
AUGEND: 00
ALU: 11111
SUM BUS: 100
DATA SET: 000
A SET: 11
B SET: 01

G SET: 0
CI: 00
CO: 00
MEM: 11
SPEC: 00000
TEST: BC5
NEXT: 1F

ROM WORD: E7E0D06051F

214 RRB3 ROTATE RIGHT B THREE BITS

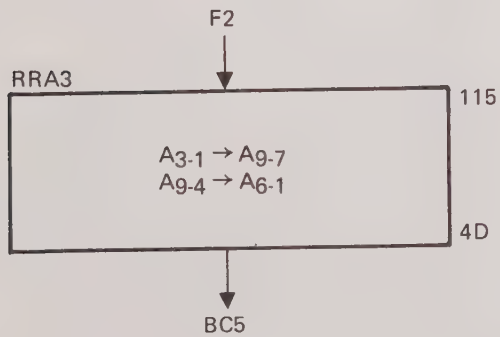


ADDEND: 111
AUGEND: 00
ALU: 11111
SUM BUS: 011
DATA SET: 000
A SET: 11
B SET: 01

G SET: 0
CI: 00
CO: 00
MEM: 11
SPEC: 00000
TEST: BC5
NEXT: 1F

ROM WORD: E7D8D06051F

215 RRA3 ROTATE RIGHT A THREE BITS

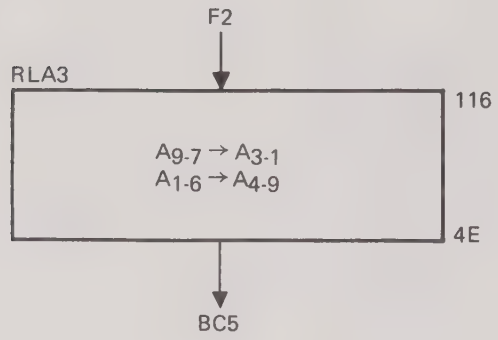


ADDEND: 110
AUGEND: 00
ALU: 11111
SUM BUS: 011
DATA SET: 000
A SET: 01
B SET: 11

G SET: 0
CI: 00
CO: 00
MEM: 11
SPEC: 00000
TEST: BC5
NEXT: 1F

ROM WORD: C7D8706051F

216 RLA3 ROTATE LEFT A THREE BITS

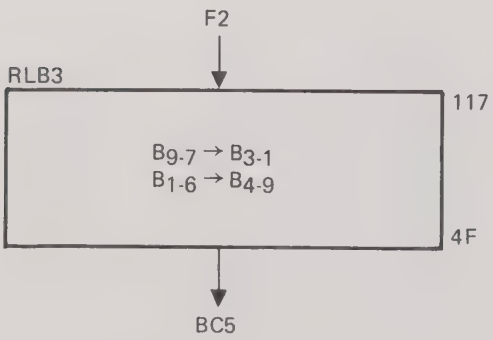


ADDEND: 110
AUGEND: 00
ALU: 11111
SUM BUS: 001
DATA SET: 000
A SET: 01
B SET: 11

G SET: 0
CI: 00
CO: 00
MEM: 11
SPEC: 00000
TEST: BC5
NEXT: 1F

ROM WORD: C7C8706051F

217 RLB3 ROTATE LEFT B THREE BITS

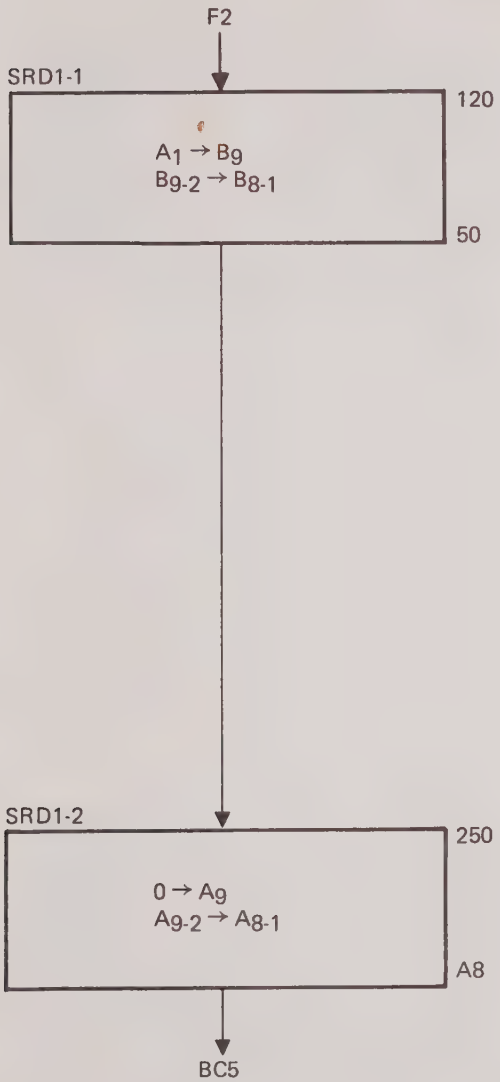


ADDEND: 111
AUGEND: 00
ALU: 11111
SUM BUS: 001
DATA SET: 000
A SET: 11
B SET: 01

G SET: 0
CI: 00
CO: 00
MEM: 11
SPEC: 00000
TEST: BC5
NEXT: 1F

ROM WORD: E7C8D06051F

220 SRD1 SHIFT RIGHT DOUBLE (AB) ONE BIT



ADDEND: 111
AUGEND: 00
ALU: 11111
SUM BUS: 101
DATA SET: 000
A SET: 11
B SET: 01

G SET: 0
CI: 00
CO: 00
MEM: 11
SPEC: SP11
TEST: 0000
NEXT: A8

ROM WORD: E7E8D0710A8

ADDEND: 110
AUGEND: 00
ALU: 11111
SUM BUS: 101
DATA SET: 000
A SET: 01
B SET: 11

G SET: 0
CI: 00
CO: 00
MEM: 11
SPEC: SP0F
TEST: BC5
NEXT: 1F

ROM WORD: C7E8706F51F

221 ARS1 ARITHMETIC RIGHT SHIFT AB ONE BIT

ADDEND: 111
AUGEND: 00
ALU: 11111
SUM BUS: 101
DATA SET: 000
A SET: 11
B SET: 01

G SET: 0
CI: 00
CO: 00
MEM: 11
SPEC: SP11
TEST: 0000
NEXT: A9

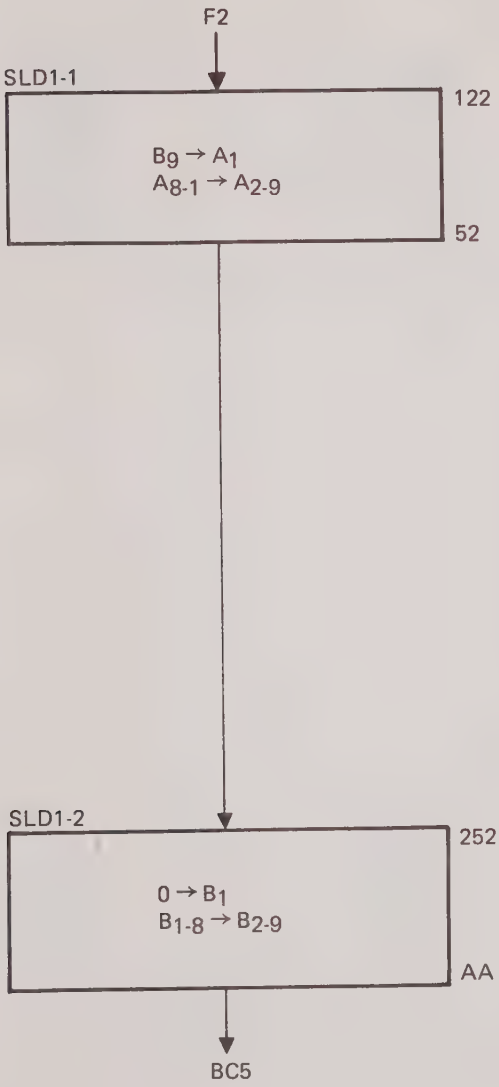
ROM WORD: E7E8D0710A9

ADDEND: 110
AUGEND: 00
ALU: 11111
SUM BUS: 101
DATA SET: 000
A SET: 01
B SET: 11

G SET: 0
CI: 00
CO: 00
MEM: 11
SPEC: SP12
TEST: BC5
NEXT: 1F

ROM WORD: C7E8707251F

222 SLD1 SHIFT LEFT DOUBLE (AB) ONE BIT



ADDEND: 110
AUGEND: 00
ALU: 11111
SUM BUS: 100
DATA SET: 000
A SET: 01
B SET: 11

G SET: 0
CI: 00
CO: 00
MEM: 11
SPEC: SP10
TEST: 0000
NEXT: AA

ROM WORD: C7E070700AA

ADDEND: 111
AUGEND: 00
ALU: 11111
SUM BUS: 100
DATA SET: 000
A SET: 11
B SET: 01

G SET: 0
CI: 00
CO: 00
MEM: 11
SPEC: SP0F
TEST: BC5
NEXT: 1F

ROM WORD: E7E0D06F51F

224 SRD3 SHIFT RIGHT DOUBLE (AB) THREE BITS

ADDEND: 111
AUGEND: 00
ALU: 11111
SUM BUS: 011
DATA SET: 000
A SET: 11
B SET: 01

G SET: 0
CI: 00
CO: 00
MEM: 11
SPEC: SP11
TEST: 0000
NEXT: AB

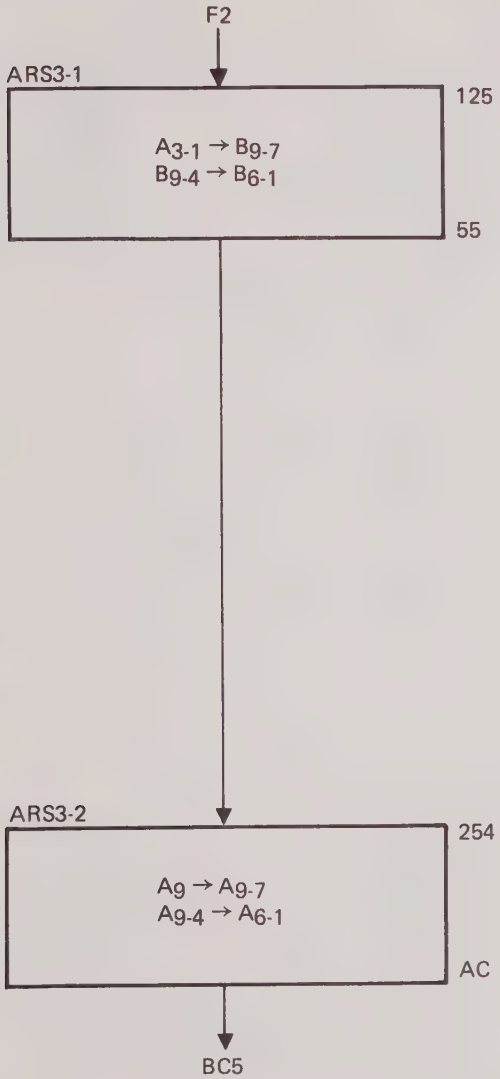
ROM WORD: E7D8D0710AB

ADDEND: 110
AUGEND: 00
ALU: 11111
SUM BUS: 011
DATA SET: 000
A SET: 01
B SET: 11

G SET: 0
CI: 00
CO: 00
MEM: 11
SPEC: SP0F
TEST: BC5
NEXT: 1F

ROM WORD: C7D8706F51F

225 ARS3 ARITHMETIC RIGHT SHIFT AB THREE BITS



ADDEND: 111
AUGEND: 00
ALU: 11111
SUM BUS: 011
DATA SET: 000
A SET: 11
B SET: 01

G SET: 0
CI: 00
CO: 00
MEM: 11
SPEC: SP11
TEST: 0000
NEXT: AC

ROM WORD: E7D8D0710AC

ADDEND: 110
AUGEND: 00
ALU: 11111
SUM BUS: 011
DATA SET: 000
A SET: 01
B SET: 11

G SET: 0
CI: 00
CO: 00
MEM: 11
SPEC: SP0F
TEST: BC5
NEXT: 1F

ROM WORD: C7D8707251F

226 SLD3 SHIFT LEFT DOUBLE (AB) THREE BITS

SLD3-1

ADDEND: 110
AUGEND: 00
ALU: 11111
SUM BUS: 01
DATA SET: 000
A SET: 01
B SET: 11

G SET: 0
CI: 00
CO: 00
MEM: 11
SPEC: SP10
TEST: 0000
NEXT: AD

ROM WORD: C7C870700AD

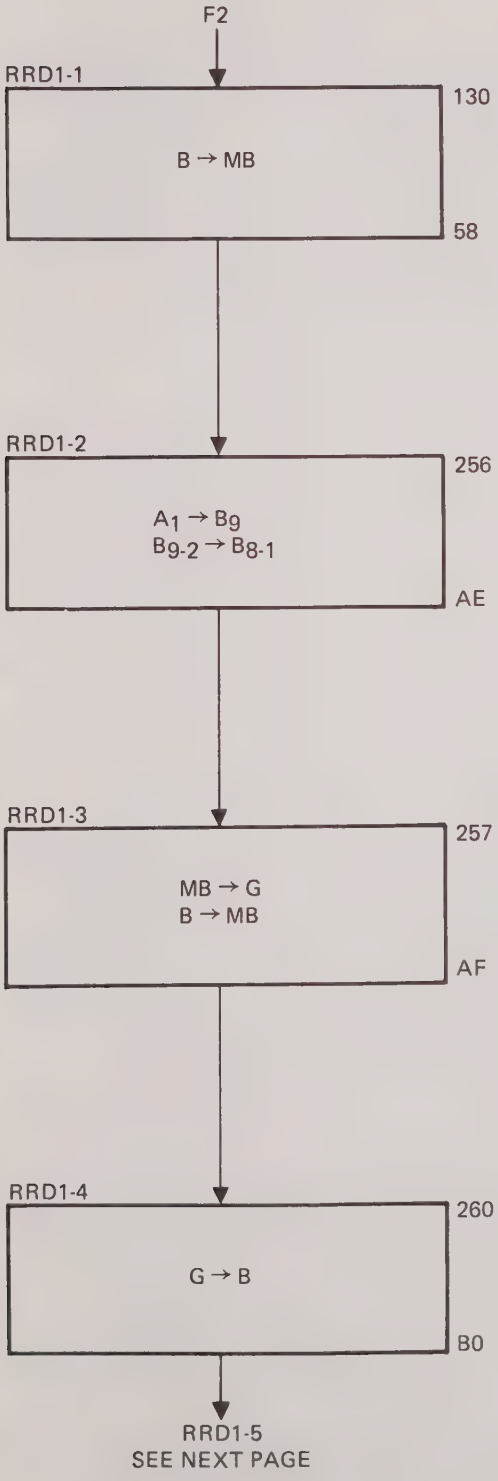
SLD3-2

ADDEND: 111
AUGEND: 000
ALU: 11111
SUM BUS: 001
DATA SET: 000
A SET: 11
B SET: 01

G SET: 0
CI: 00
CO: 00
MEM: 11
SPEC: SP0F
TEST: BC5
NEXT: 1F

ROM WORD: E7C8D06F51F

230 RRD1 ROTATE RIGHT DOUBLE (AB) ONE BIT



ADDEND: 111
AUGEND: 00
ALU: 11111
SUM BUS: 110
DATA SET: 101
A SET: 11
B SET: 11

G SET: 0
CI: 00
CO: 00
MEM: 11
SPEC: 00000
TEST: 0000
NEXT: AE

ROM WORD: E7F5F0600AE

ADDEND: 111
AUGEND: 00
ALU: 11111
SUM BUS: 101
DATA SET: 000
A SET: 11
B SET: 01

G SET: 0
CI: 00
CO: 00
MEM: 11
SPEC: SP11
TEST: 0000
NEXT: AF

ROM WORD: E7E8D0710AF

ADDEND: 111
AUGEND: 00
ALU: 11111
SUM BUS: 110
DATA SET: 101
A SET: 11
B SET: 11

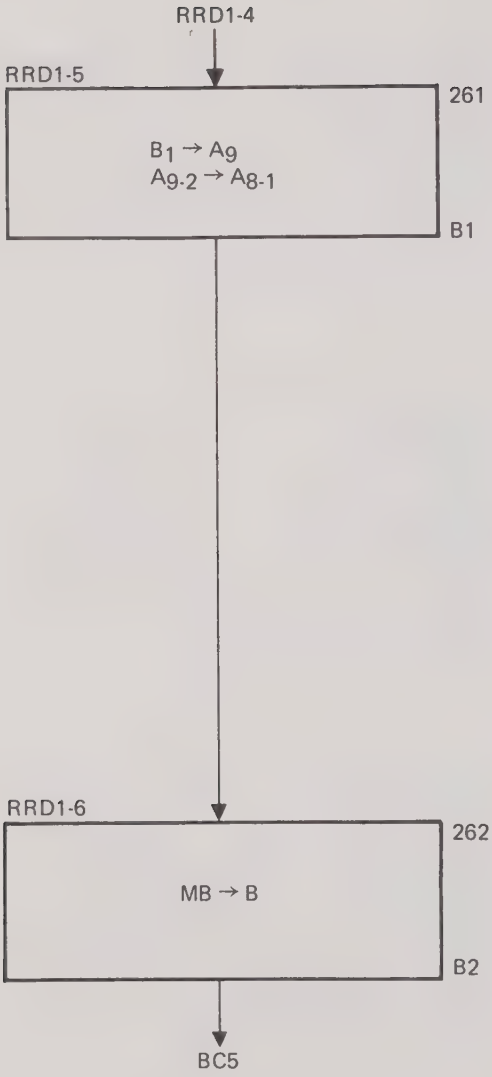
G SET: 1
CI: 00
CO: 00
MEM: 11
SPEC: 00000
TEST: 0000
NEXT: B0

ROM WORD: E7F5F8600B0

ADDEND: 000
AUGEND: 01
ALU: 10101
SUM BUS: 110
DATA SET: 000
A SET: 11
B SET 01

G SET: 0
CI: 00
CO: 00
MEM: 11
SPEC: 00000
TEST: 0000
NEXT: B1

ROM WORD: 0D70D0600B1



ADDEND: 110
AUGEND: 00
ALU: 11111
SUM BUS: 101
DATA SET: 000
A SET: 01
B SET: 11

G SET: 0
CI: 00
CO: 00
MEM: 11
SPEC: SP10
TEST: 0000
NEXT: B2

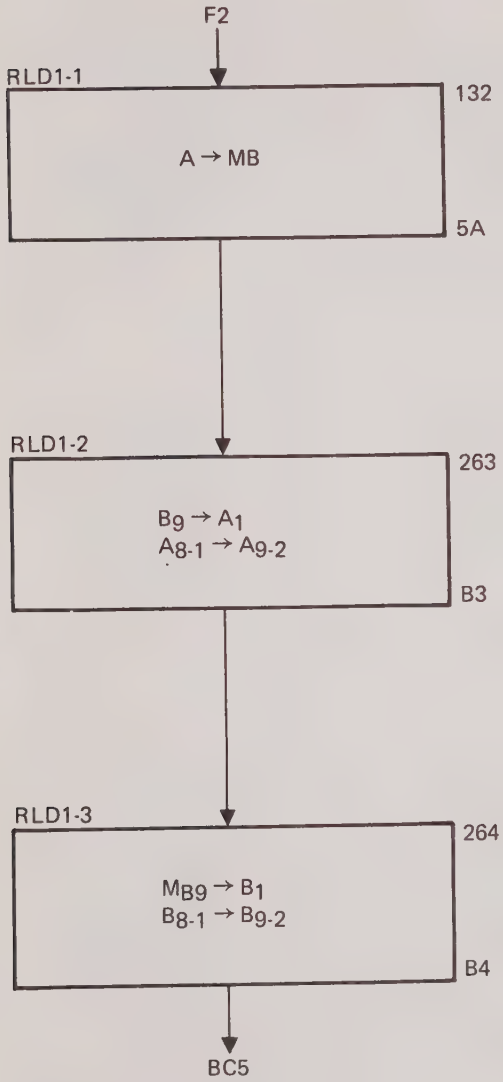
ROM WORD: C7E870700B2

ADDEND: 100
AUGEND: 00
ALU: 11111
SUM BUS: 110
DATA SET: 000
A SET: 11
B SET: 01

G SET: 0
CI: 00
CO: 00
MEM: 11
SPEC: 00000
TEST: BC5
NEXT: 1F

ROM WORD: 87F0D06051F

232 RLD1 ROTATE LEFT DOUBLE (AB) ONE BIT



ADDEND: 110
AUGEND: 00
ALU: 11111
SUM BUS: 110
DATA SET: 101
A SET: 11
B SET: 11

G SET: 0
CI: 00
CO: 00
MEM: 11
SPEC: 00000
TEST: 0000
NEXT: B3

ROM WORD: C7F5F0600B3

ADDEND: 110
AUGEND: 00
ALU: 11111
SUM BUS: 100
DATA SET: 000
A SET: 01
B SET: 11

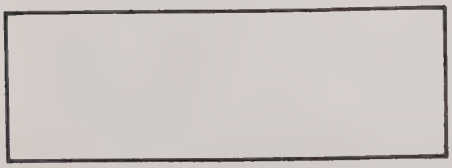
G SET: 0
CI: 00
CO: 00
MEM: 11
SPEC: SP10
TEST: 0000
NEXT: B4

ROM WORD: C7E070700B4

ADDEND: 111
AUGEND: 00
ALU: 11111
SUM BUS: 100
DATA SET: 000
A SET: 11
B SET: 01

G SET: 0
CI: 00
CO: 00
MEM: 11
SPEC: SP12
TEST: BC5
NEXT: 1F

ROM WORD: E7E0D07251F

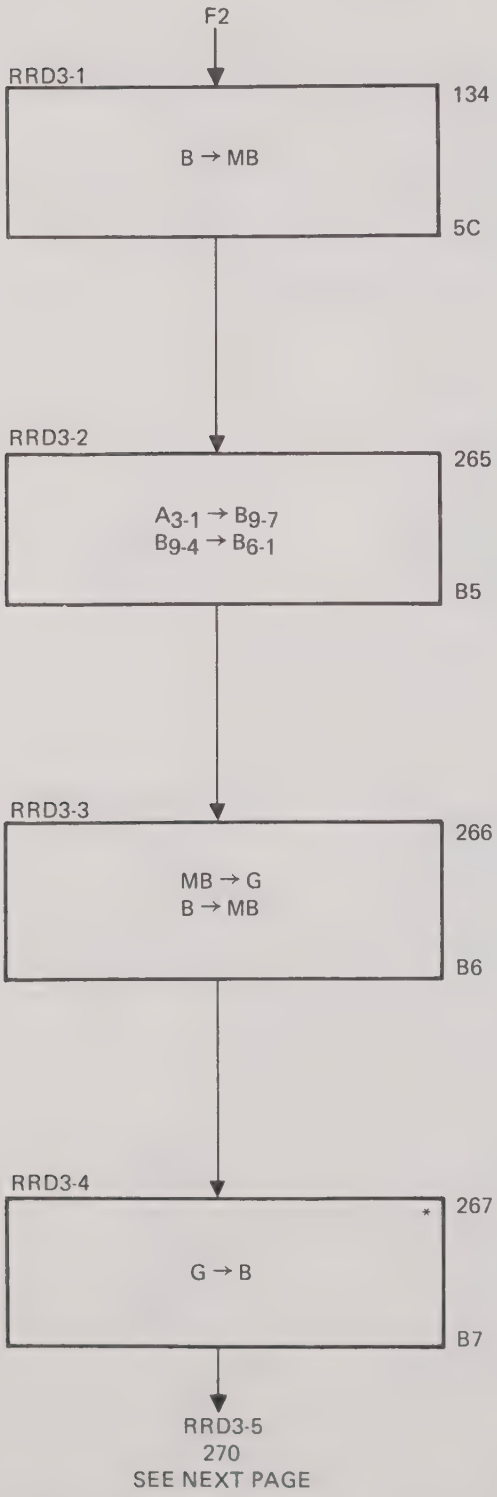


ADDEND:
AUGEND:
ALU:
SUM BUS:
DATA SET:
A SET:
B SET

G SET:
CI:
CO:
MEM:
SPEC:
TEST:
NEXT:

ROM WORD:

234 RRD3 ROTATE RIGHT DOUBLE (AB) THREE BITS



ADDEND: 111
AUGEND: 00
ALU: 11111
SUM BUS: 110
DATA SET: 101
A SET: 11
B SET: 11

G SET: 0
CI: 00
CO: 00
MEM: 11
SPEC: 00000
TEST: 0000
NEXT: B5

ROM WORD: E7F5F0600B5

ADDEND: 111
AUGEND: 00
ALU: 11111
SUM BUS: 011
DATA SET: 000
A SET: 11
B SET: 01

G SET: 0
CI: 00
CO: 00
MEM: 11
SPEC: SP11
TEST: 0000
NEXT:

ROM WORD: E7D8D0710B6

ADDEND: 111
AUGEND: 00
ALU: 11111
SUM BUS: 110
DATA SET: 101
A SET: 11
B SET: 11

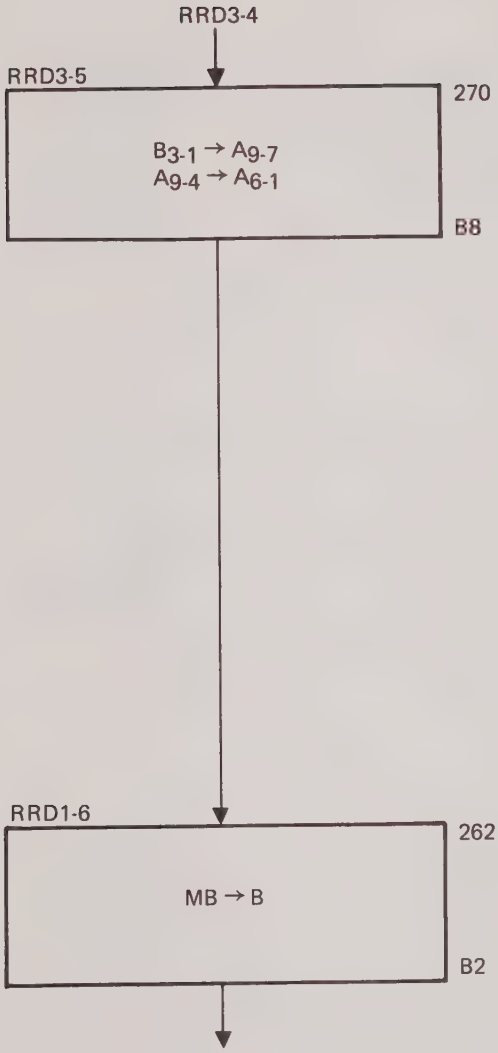
G SET: 0
CI: 00
CO: 00
MEM: 11
SPEC: 00000
TEST: 0000
NEXT: B7

ROM WORD: E7F5F8600B7

ADDEND: 000
AUGEND: 01
ALU: 10101
SUM BUS: 110
DATA SET: 000
A SET: 11
B SET 01

G SET: 0
CI: 00
CO: 00
MEM: 11
SPEC: 00000
TEST: 0000
NEXT: B8

ROM WORD: 0D70D0600B8



ADDEND: 110
AUGEND: 00
ALU: 11111
SUM BUS: 011
DATA SET: 000
A SET: 01
B SET: 11

G SET: 0
CI: 00
CO: 00
MEM: 11
SPEC: SP10
TEST: 0000
NEXT: B2

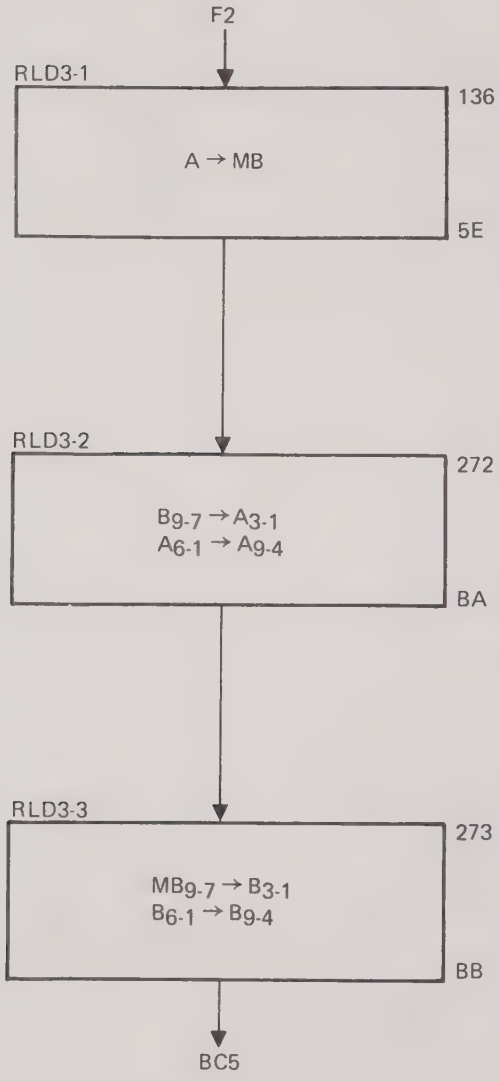
ROM WORD: C7D870700B2

ADDEND: 100
AUGEND: 00
ALU: 11111
SUM BUS: 110
DATA SET: 000
A SET: 11
B SET: 01

G SET: 0
CI: 00
CO: 00
MEM: 11
SPEC: 00000
TEST: BC5
NEXT: 1F

ROM WORD: 87F0D06051F

236 RLD3 ROTATE LEFT DOUBLE (AB) THREE BITS



ADDEND: 110
AUGEND: 00
ALU: 11111
SUM BUS: 110
DATA SET: 101
A SET: 11
B SET: 11

G SET: 0
CI: 00
CO: 00
MEM: 11
SPEC: 00000
TEST: 0000
NEXT: BA

ROM WORD: C7F5F0600BA

ADDEND: 110
AUGEND: 00
ALU: 11111
SUM BUS: 001
DATA SET: 000
A SET: 01
B SET: 11

G SET: 0
CI: 00
CO: 00
MEM: 11
SPEC: SP10
TEST: 0000
NEXT: BB

ROM WORD: C7C870700BB

ADDEND: 111
AUGEND: 00
ALU: 11111
SUM BUS: 001
DATA SET: 000
A SET: 11
B SET: 01

G SET: 0
CI: 00
CO: 00
MEM: 11
SPEC: SP12
TEST: BC5
NEXT: 1F

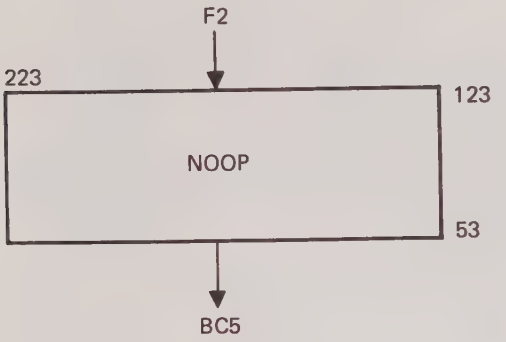
ROM WORD: E7C8D07251F

ADDEND:
AUGEND:
ALU:
SUM BUS:
DATA SET:
A SET:
B SET

G SET:
CI:
CO:
MEM:
SPEC:
TEST:
NEXT:

ROM WORD:

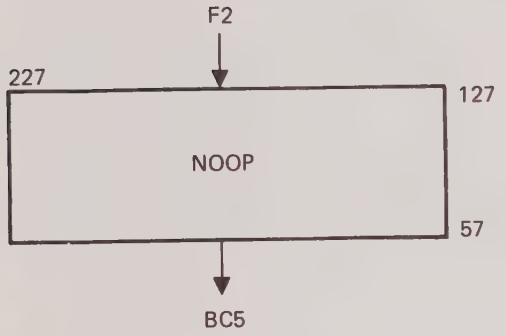
223, 227, 231, 233, 235, 237 UNUSED OP CODES



ADDEND: 000
AUGEND: 00
ALU: 00000
SUM BUS: 00
DATA SET: 000
A SET: 11
B SET: 11

G SET: 0
CI: 00
CO: 00
MEM: 11
SPEC: 00000
TEST: BC5
NEXT: 1F

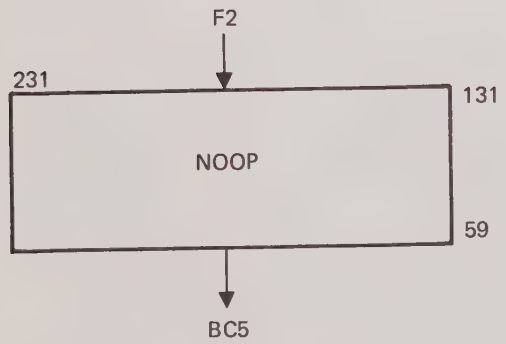
ROM WORD: 0000F06051F



ADDEND: 000
AUGEND: 00
ALU: 00000
SUM BUS: 000
DATA SET: 000
A SET: 11
B SET: 11

G SET: 0
CI: 00
CO: 00
MEM: 11
SPEC: 00000
TEST: BC5
NEXT: 1F

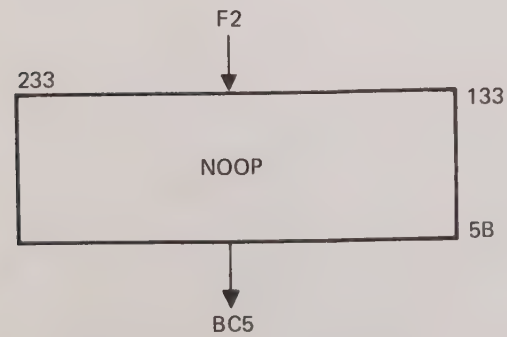
ROM WORD: 0000F06051F



ADDEND: 000
AUGEND: 00
ALU: 00000
SUM BUS: 000
DATA SET: 000
A SET: 11
B SET: 11

G SET: 0
CI: 00
CO: 00
MEM: 11
SPEC: 00000
TEST: BC5
NEXT: 1F

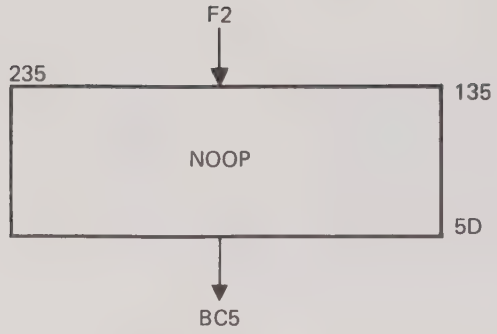
ROM WORD: 0000F06051F



ADDEND: 000
AUGEND: 00
ALU: 00000
SUM BUS: 00
DATA SET: 000
A SET: 11
B SET 11

G SET: 0
CI: 00
CO: 00
MEM: 11
SPEC: 00000
TEST: BC5
NEXT: 1F

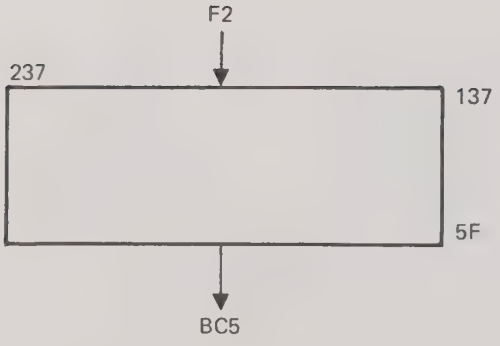
ROM WORD: 0000F06051F



ADDEND: 000
AUGEND: 00
ALU: 00000
SUM BUS: 000
DATA SET: 000
A SET: 11
B SET: 11

G SET: 0
CI: 00
CO: 00
MEM: 11
SPEC: 00000
TEST: BC5
NEXT: 1F

ROM WORD: 0000F06051F

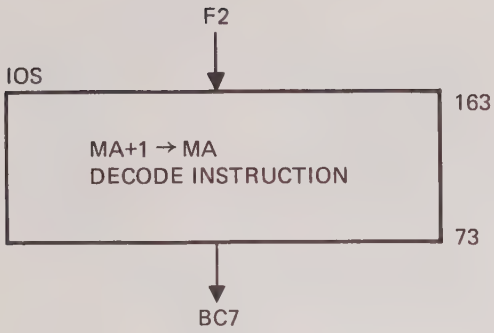


ADDEND: 000
AUGEND: 00
ALU: 00000
SUM BUS: 000
DATA SET: 000
A SET: 11
B SET: 11

G SET: 0
CI: 00
CO: 00
MEM: 11
SPEC: 00000
TEST: BC5
NEXT: 1F

ROM WORD: 0000F06051F

COMMON OPERATION, I/O INSTRUCTIONS



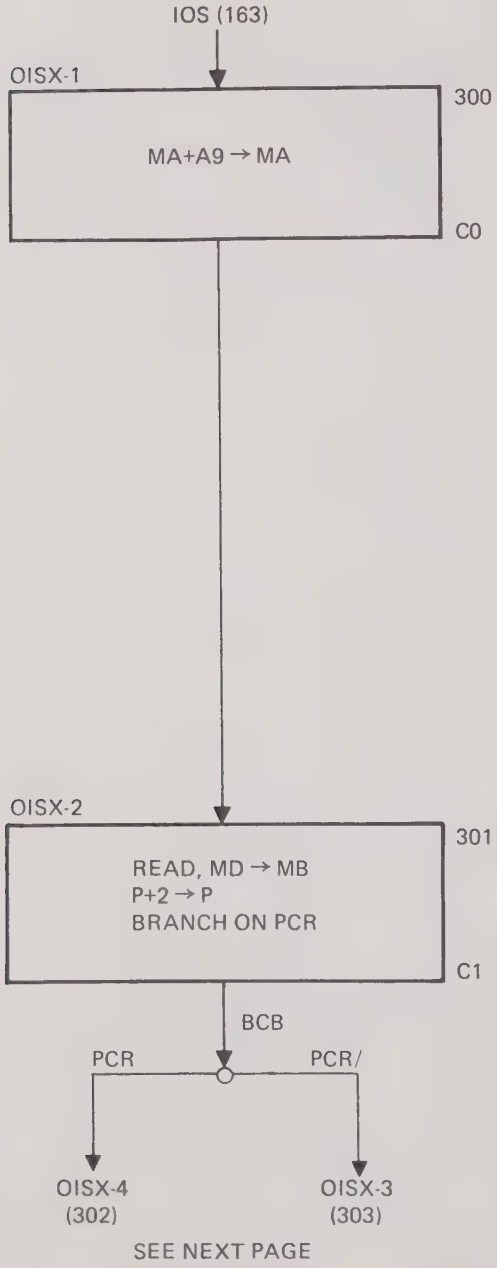
ADDEND: 000
AUGEND: 00
ALU: 00000
SUM BUS: 110
DATA SET: 001
A SET: 11
B SET: 11

G SET: 0
CI: 01
CO: 00
MEM: 11
SPEC: 00000
TEST: BC7
NEXT: FF

ROM WORD: 0031F2607FF

PC1-9 = DATA LINES FROM I/O
CP1-9 = DATA LINES TO I/O
PCR = I/O READY FROM I/O
CS = I/O DATA READY
PCD = I/O DMC REQUEST
PCW = DMC OUTPUT FROM MEMORY
PCW/ = DMC INPUT TO MEMORY
PCE/ = TERMINATE DATA TRANSFER
CPC = OCI COMMAND STROBE

24A OUTPUT IMMEDIATE; SKIP IF COMPLETE



ADDEND: 000
AUGEND: 00
ALU: 10010
SUM BUS: 110
DATA SET: 001
A SET: 11
B SET: 11

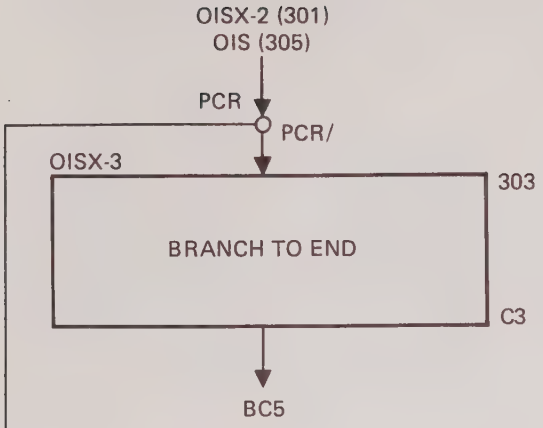
G SET: 0
CI: 00
CO: 00
MEM: 11
SPEC: SP0B
TEST: 0000
NEXT: C1

ROM WORD: 04B1F06B0C1

ADDEND: 001
AUGEND: 00
ALU: 10010
SUM BUS: 110
DATA SET: 010
A SET: 11
B SET: 11

G SET: 0
CI: 00
CO: 00
MEM: 10
SPEC: SP0B
TEST: BCB
NEXT: C3

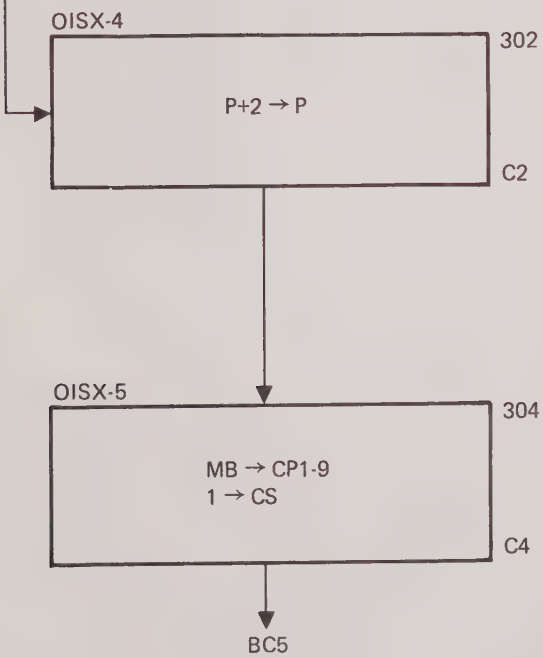
ROM WORD: 24B2F04CBC3



ADDEND: 000
AUGEND: 00
ALU: 000000
SUM BUS: 000
DATA SET: 000
A SET: 11
B SET: 11

G SET: 0
CI: 00
CO: 00
MEM: 11
SPEC: 00000
TEST: BC5
NEXT: 1F

ROM WORD: 0000F06051F



ADDEND: 001
AUGEND: 00
ALU: 10010
SUM BUS: 110
DATA SET: 010
A SET: 11
B SET: 11

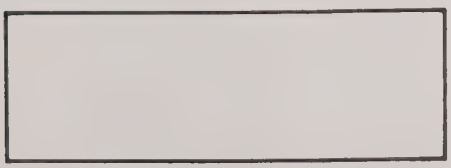
G SET: 0
CI: 00
CO: 00
MEM: 11
SPEC: SP0C
TEST: 0000
NEXT: C4

ROM WORD: 24B2F06C0C4

ADDEND: 100
AUGEND: 00
ALU: 11111
SUM BUS: 110
DATA SET: 000
A SET: 11
B SET: 11

G SET: 0
CI: 00
CO: 00
MEM: 11
SPEC: SP14
TEST: BC5
NEXT: 1F

ROM WORD: 87F0F07451F

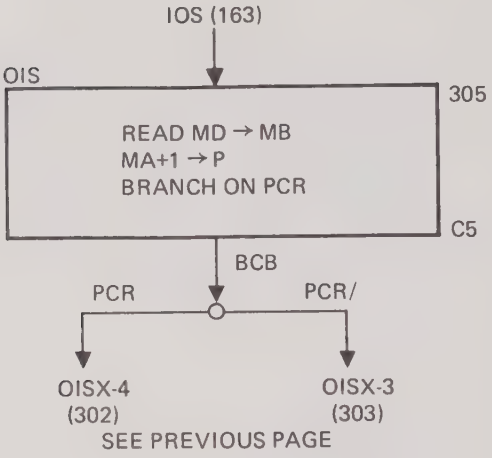


ADDEND:
AUGEND:
ALU:
SUM BUS:
DATA SET:
A SET:
B SET

G SET:
CI:
CO:
MEM:
SPEC:
TEST:
NEXT:

ROM WORD:

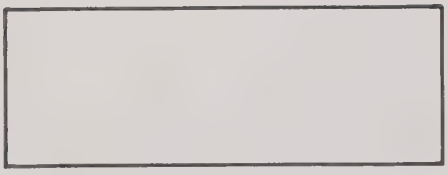
25A OIS OUTPUT IMMEDIATE, SKIP IF COMPLETE



ADDEND: 000
AUGEND: 00
ALU: 00000
SUM BUS: 110
DATA SET: 010
A SET: 11
B SET: 11

G SET: 0
CI: 01
CO: 00
MEM: 10
SPEC: 00000
TEST: BCB
NEXT: C3

ROM WORD: 0032F240BC3

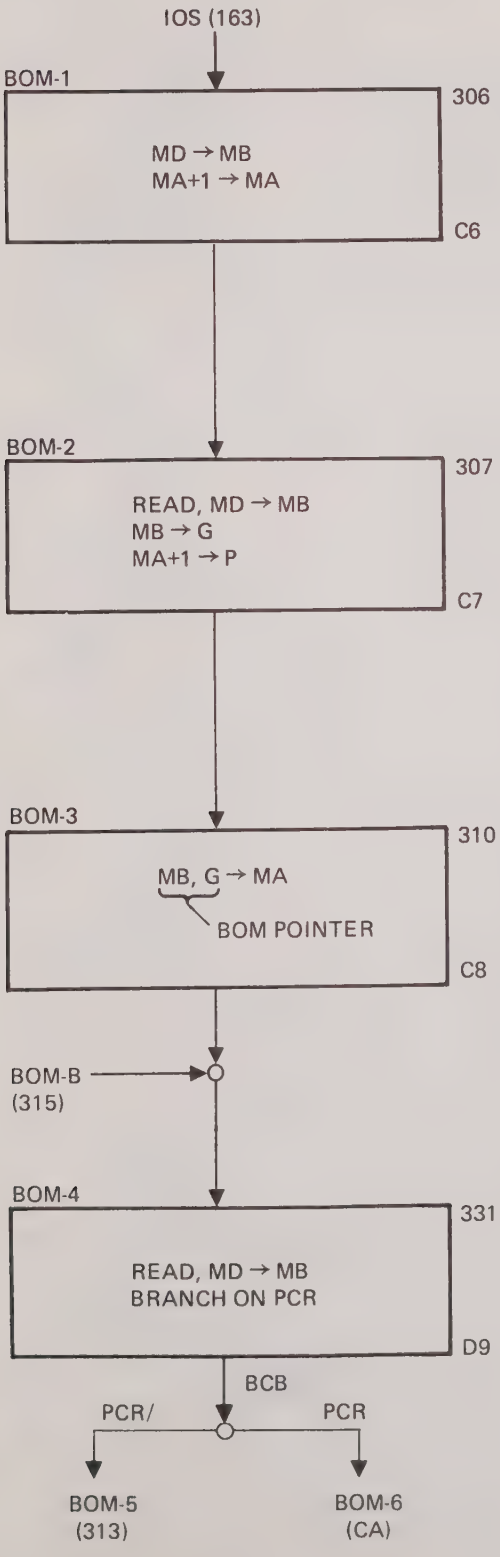


ADDEND:
AUGEND:
ALU:
SUM BUS:
DATA SET:
A SET:
B SET:

G SET:
CI:
CO:
MEM:
SPEC:
TEST:
NEXT:

ROM WORD:

26A BOM BLOW OUT OF MEMORY



ADDEND: 000
AUGEND: 00
ALU: 00000
SUM BUS: 110
DATA SET: 001
A SET: 11
B SET: 11

G SET: 0
CI: 01
CO: 00
MEM: 10
SPEC: 00000
TEST: 0000
NEXT: C7

ROM WORD: 0031F2400C7

ADDEND: 000
AUGEND: 00
ALU: 00000
SUM BUS: 110
DATA SET: 010
A SET: 11
B SET: 11

G SET: 1
CI: 01
CO: 00
MEM: 10
SPEC: 00000
TEST: 0000
NEXT: C8

ROM WORD: 0032FA400C8

ADDEND: 101
AUGEND: 00
ALU: 11111
SUM BUS: 110
DATA SET: 001
A SET: 11
B SET: 11

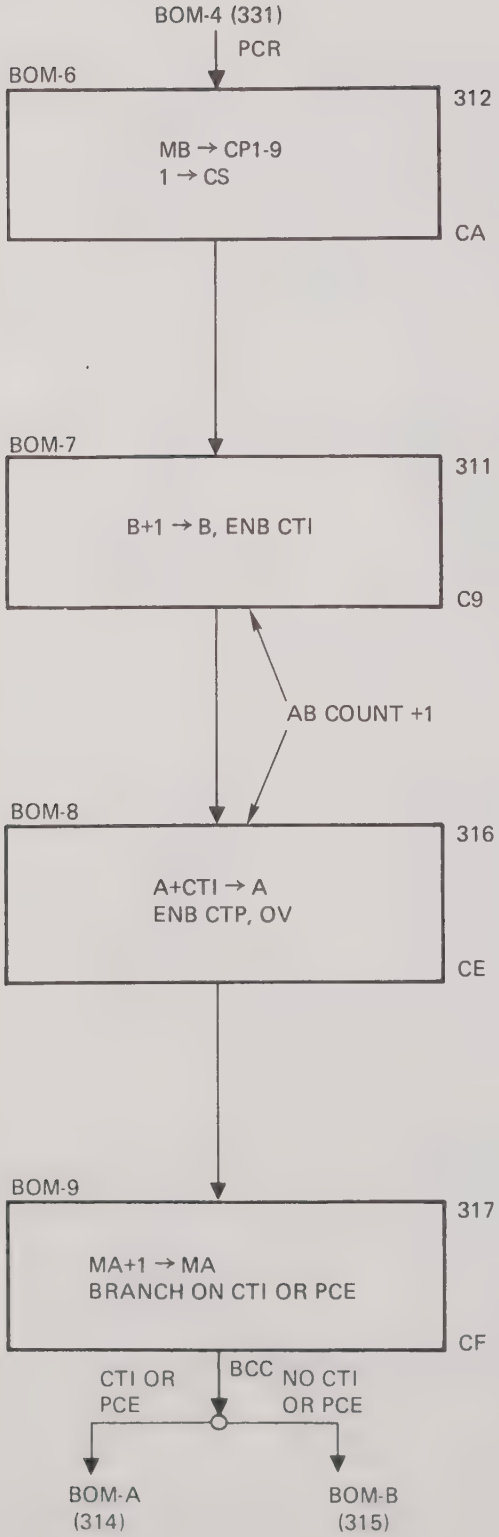
G SET: 0
CI: 00
CO: 00
MEM: 11
SPEC: 00000
TEST: 0000
NEXT: D9

ROM WORD: A7F1F0600D9

ADDEND: 000
AUGEND: 00
ALU: 00000
SUM BUS: 000
DATA SET: 000
A SET: 11
B SET 11

G SET: 0
CI: 00
CO: 00
MEM: 10
SPEC: 00000
TEST: BCB
NEXT: CB

ROM WORD: 0000F040BCB



ADDEND: 100
AUGEND: 00
ALU: 10000
SUM BUS: 100
DATA SET: 000
A SET: 11
B SET: 11

G SET: 0
CI: 00
CO: 00
MEM: 11
SPEC: SP14
TEST: 0000
NEXT: C9

ROM WORD: 87F0F0740C9

ADDEND: 111
AUGEND: 00
ALU: 00000
SUM BUS: 110
DATA SET: 000
A SET: 11
B SET: 01

G SET: 0
CI: 01
CO: 00
MEM: 11
SPEC: 00000
TEST: 0000
NEXT: CE

ROM WORD: E030D2600CE

ADDEND: 110
AUGEND: 10
ALU: 00000
SUM BUS: 110
DATA SET: 000
A SET: 01
B SET: 11

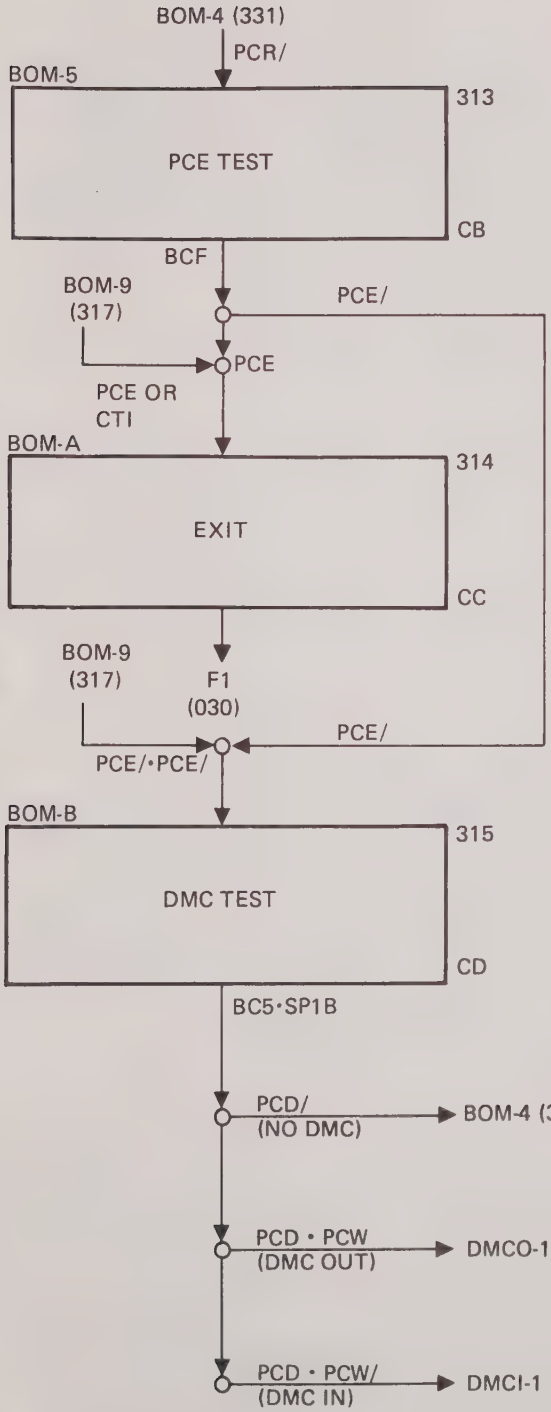
G SET: 0
CI: 11
CO: 01
MEM: 11
SPEC: 00000
TEST: 0000
NEXT: CF

ROM WORD: D03076E00CF

ADDEND: 000
AUGEND: 00
ALU: 00000
SUM BUS: 110
DATA SET: 001
A SET: 11
B SET 11

G SET: 0
CI: 01
CO: 00
MEM: 11
SPEC: 00000
TEST: BCC
NEXT: CD

ROM WORD: 0031F260CCD



ADDEND: 000
AUGEND: 00
ALU: 00000
SUM BUS: 000
DATA SET: 000
A SET: 11
B SET: 11

G SET: 0
CI: 00
CO: 00
MEM: 11
SPEC: 00000
TEST: BCF
NEXT: CD

ROM WORD: 0000F060FCD

ADDEND: 000
AUGEND: 00
ALU: 00000
SUM BUS: 000
DATA SET: 000
A SET: 11
B SET: 11

G SET: 0
CI: 00
CO: 00
MEM: 11
SPEC: 00000
TEST: 0000
NEXT: 18

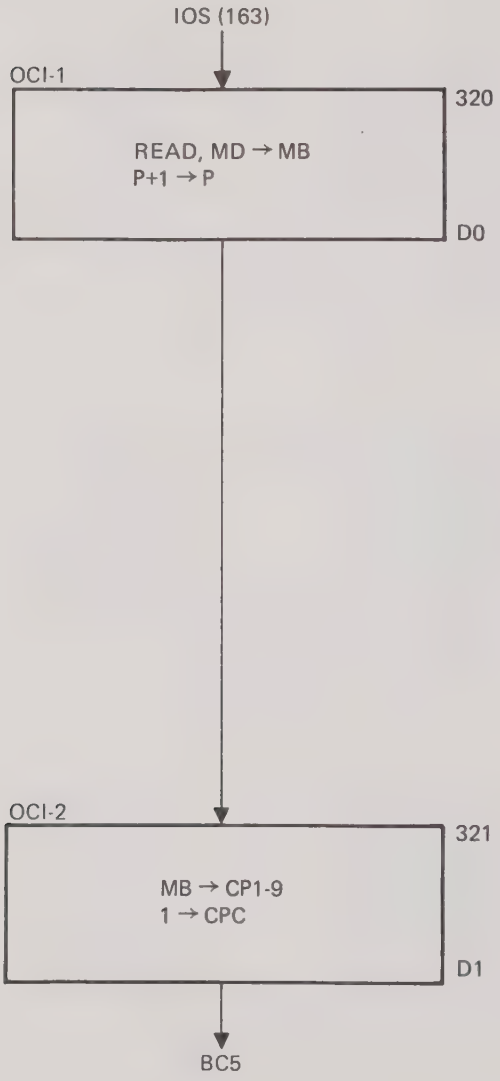
ROM WORD: 0000F060018

ADDEND: 000
AUGEND: 00
ALU: 00000
SUM BUS: 000
DATA SET: 000
A SET: 11
B SET: 11

G SET: 0
CI: 00
CO: 00
MEM:
SPEC: SP1B
TEST: BC5
NEXT: DB

ROM WORD: 0000F07B5DB

27A OCI OUTPUT CONTROL IMMEDIATE



ADDEND: 001
AUGEND: 00
ALU: 00000
SUM BUS: 110
DATA SET: 010
A SET: 11
B SET: 11

G SET: 0
CI: 01
CO: 00
MEM: 10
SPEC: 00000
TEST: 0000
NEXT: D1

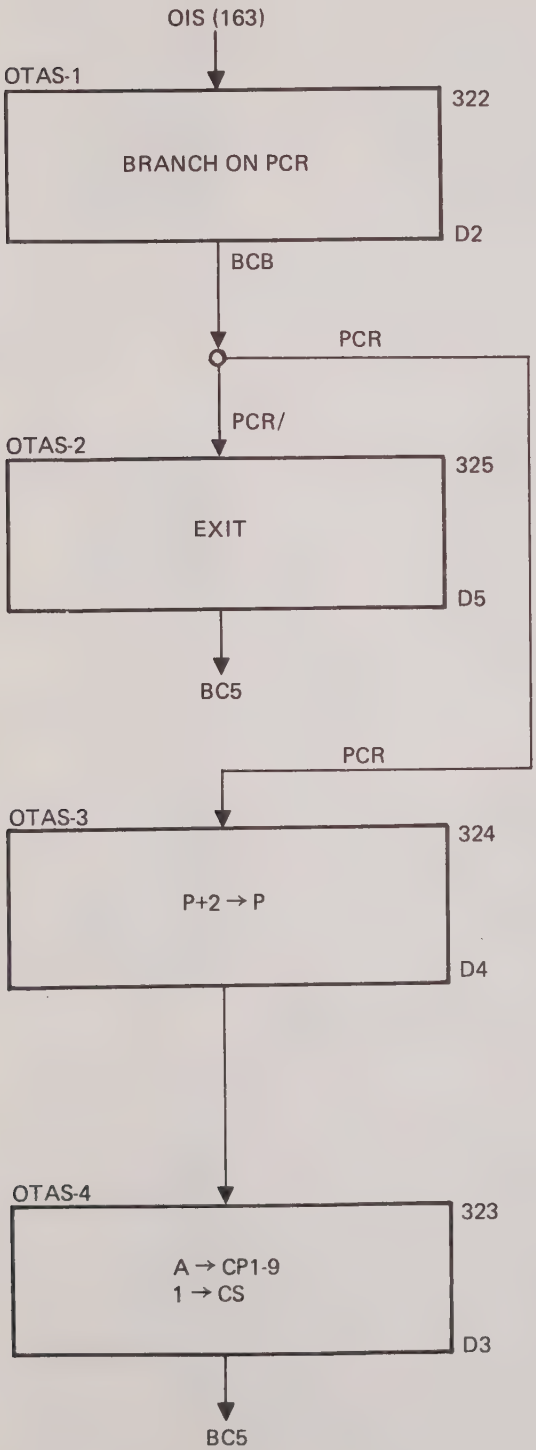
ROM WORD: 2032F2400D1

ADDEND: 100
AUGEND: 00
ALU: 11111
SUM BUS: 110
DATA SET: 000
A SET: 11
B SET: 11

G SET: 0
CI: 00
CO: 00
MEM: 11
SPEC: SP15
TEST: BC5
NEXT: 1F

ROM WORD: 87F0F07551F

30A OTAS OUTPUT A, SKIP IF COMPLETE



ADDEND: 000
AUGEND: 00
ALU: 00000
SUM BUS: 000
DATA SET: 000
A SET: 11
B SET: 11

G SET: 0
CI: 00
CO: 00
MEM: 11
SPEC: 00000
TEST: BCB
NEXT: D5

ROM WORD: 0000F060BD5

ADDEND: 000
AUGEND: 00
ALU: 00000
SUM BUS: 000
DATA SET: 000
A SET: 11
B SET: 11

G SET: 0
CI: 00
CO: 00
MEM: 11
SPEC: 00000
TEST: BC5
NEXT: 1F

ROM WORD: 0000F06051F

ADDEND: 001
AUGEND: 00
ALU: 10010
SUM BUS: 110
DATA SET: 010
A SET: 11
B SET: 11

G SET: 0
CI: 00
CO: 00
MEM: 11
SPEC: SP0C
TEST: 0000
NEXT: D3

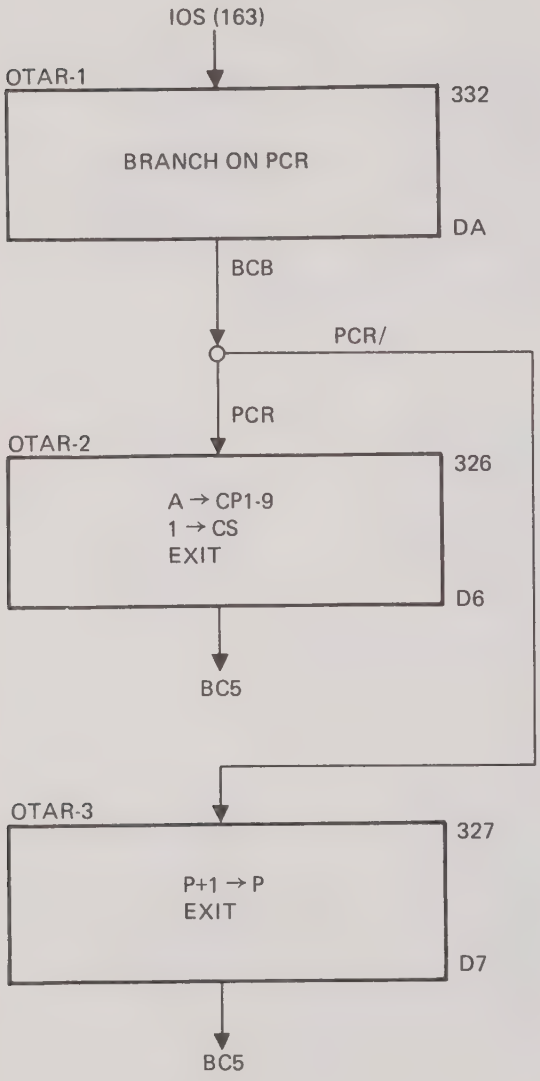
ROM WORD: 24B2F06C0D3

ADDEND: 110
AUGEND: 00
ALU: 11111
SUM BUS: 110
DATA SET: 000
A SET: 11
B SET 11

G SET: 0
CI: 00
CO: 00
MEM: 11
SPEC: SP14
TEST: BC5
NEXT: 1F

ROM WORD: C7F0F07451F

31A OTAR OUTPUT A, REPEAT UNTIL COMPLETE



ADDEND: 000
AUGEND: 00
ALU: 00000
SUM BUS: 000
DATA SET: 000
A SET: 11
B SET: 11

G SET: 0
CI: 00
CO: 00
MEM: 11
SPEC: 00000
TEST: BCB
NEXT:

ROM WORD: 0000F060BD7

ADDEND: 110
AUGEND: 00
ALU: 11111
SUM BUS: 110
DATA SET: 000
A SET: 11
B SET: 11

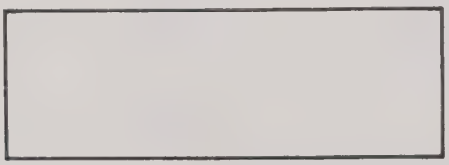
G SET: 0
CI: 00
CO: 00
MEM: 11
SPEC: SP14
TEST: BC5
NEXT: 1F

ROM WORD: C7F0F07451F

ADDEND: 001
AUGEND: 00
ALU: 11110
SUM BUS: 110
DATA SET: 010
A SET: 11
B SET: 11

G SET: 0
CI: 00
CO: 00
MEM: 11
SPEC: 00000
TEST: BC5
NEXT: 1F

ROM WORD: 27B2F06051F

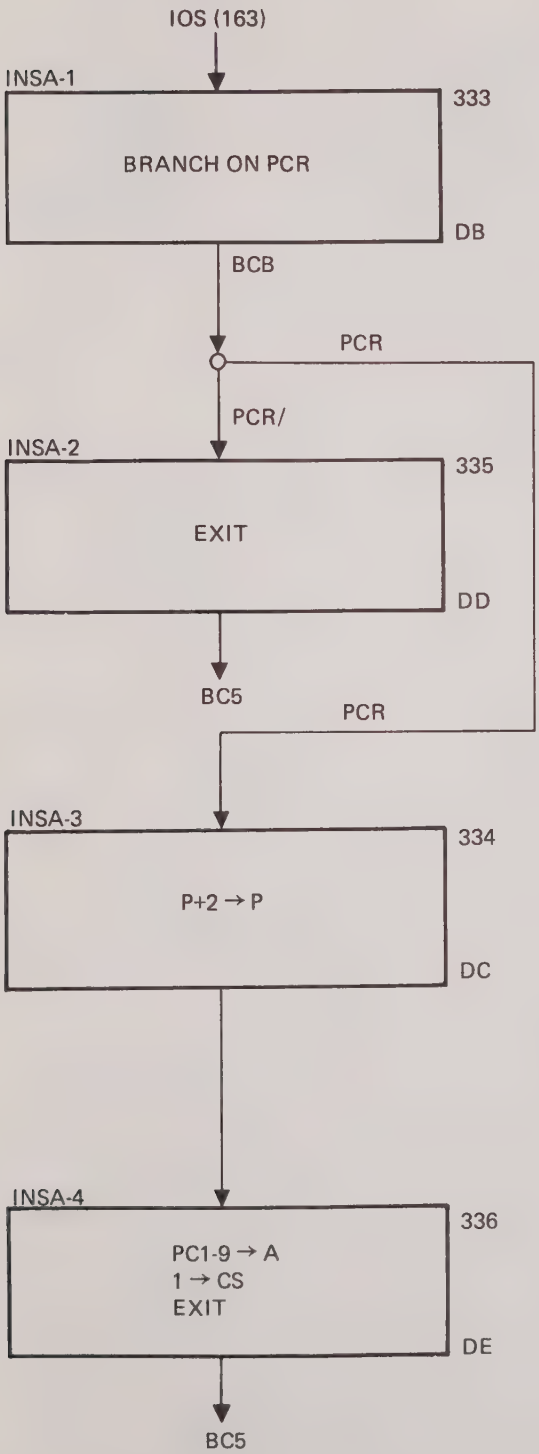


ADDEND:
AUGEND:
ALU:
SUM BUS:
DATA SET:
A SET:
B SET

G SET:
CI:
CO:
MEM:
SPEC:
TEST:
NEXT:

ROM WORD:

32A INAS INPUT TO A SKIP IF COMPLETE



ADDEND: 000
AUGEND: 00
ALU: 00000
SUM BUS: 000
DATA SET: 000
A SET: 11
B SET: 11

G SET: 0
CI: 00
CO: 00
MEM: 11
SPEC: 00000
TEST: BCB
NEXT: DD

ROM WORD: 0000F060BDD

ADDEND: 000
AUGEND: 00
ALU: 00000
SUM BUS: 000
DATA SET: 000
A SET: 11
B SET: 11

G SET: 0
CI: 00
CO: 00
MEM: 11
SPEC: 00000
TEST: BC5
NEXT: 1F

ROM WORD: 0000F06051F

ADDEND: 001
AUGEND: 00
ALU: 10010
SUM BUS: 110
DATA SET: 010
A SET: 11
B SET: 11

G SET: 0
CI: 00
CO: 00
MEM: 11
SPEC: SP0C
TEST: 0000
NEXT: DE

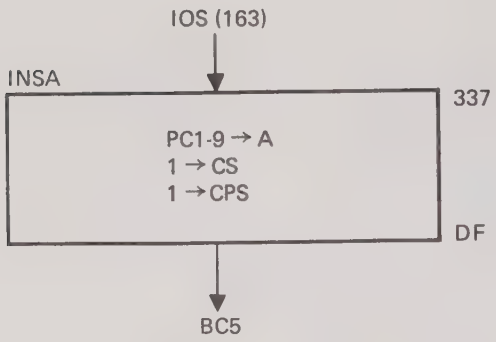
ROM WORD: 24B2F06C0DE

ADDEND: 000
AUGEND: 00
ALU: 00000
SUM BUS: 000
DATA SET: 000
A SET: 01
B SET 11

G SET: 0
CI: 00
CO: 00
MEM: 11
SPEC: SP14
TEST: BC5
NEXT: 1F

ROM WORD: 0000707451F

33A INSA INPUT STATUS TO A

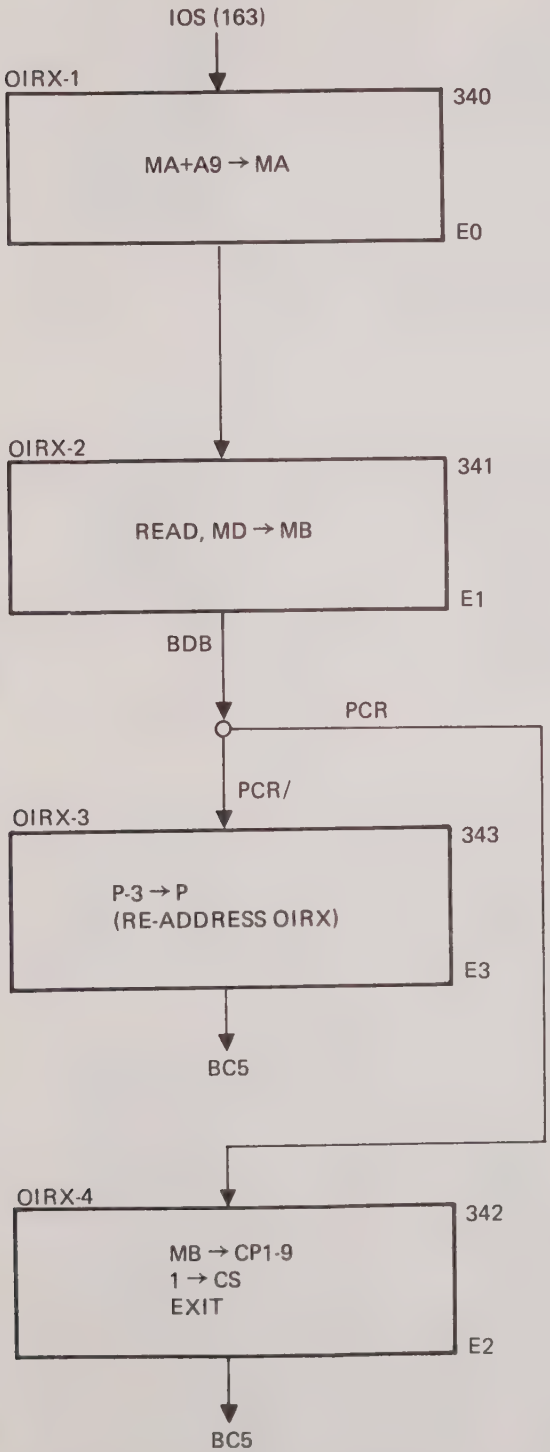


ADDEND: 000
AUGEND: 00
ALU: 00000
SUM BUS: 000
DATA SET: 000
A SET: 01
B SET: 11

G SET: 0
CI: 00
CO: 00
MEM: 11
SPEC: SP14
TEST: BC5
NEXT: 1F

ROM WORD: 0000707451F

34A OIRX OUTPUT IMMEDIATE, REPEAT UNTIL COMPLETE, INDEXED



ADDEND: 000
AUGEND: 00
ALU: 10010
SUM BUS: 110
DATA SET: 001
A SET: 11
B SET: 11

G SET: 0
CI: 00
CO: 00
MEM: 11
SPEC: SP0B
TEST: 0000
NEXT: E1

ROM WORD: 04B1F06B0E1

ADDEND: 001
AUGEND: 00
ALU: 10010
SUM BUS: 110
DATA SET: 010
A SET: 11
B SET: 11

G SET: 0
CI: 00
CO: 00
MEM: 10
SPEC: SP0C
TEST: BCB
NEXT: E3

ROM WORD: 24B2F04CBE3

ADDEND: 001
AUGEND: 00
ALU: 01100
SUM BUS: 110
DATA SET: 010
A SET: 11
B SET: 11

G SET: 0
CI: 00
CO: 00
MEM: 11
SPEC: SP0C
TEST: BC5
NEXT: 1F

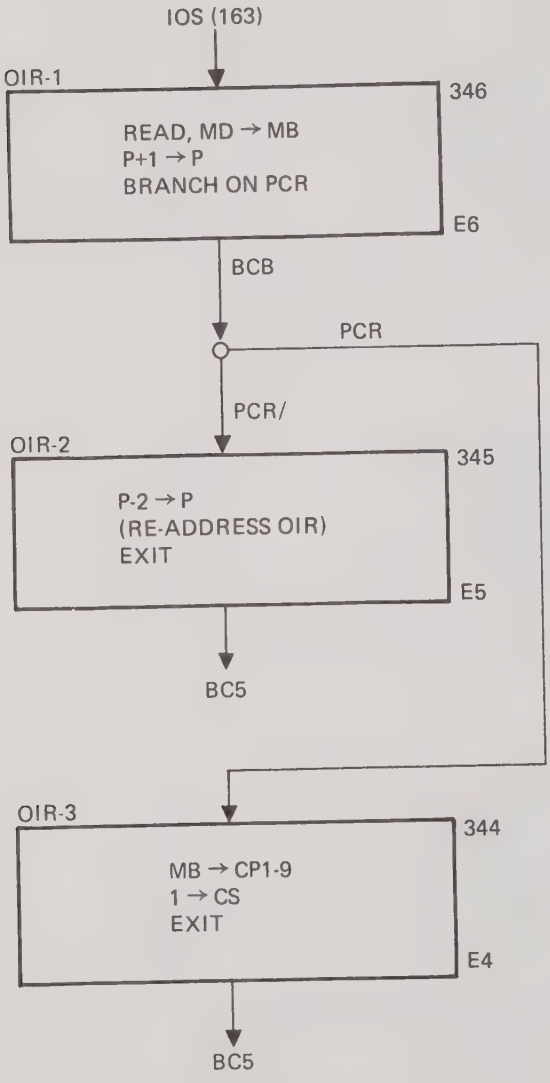
ROM WORD: 2332F06C51F

ADDEND: 100
AUGEND: 00
ALU: 11111
SUM BUS: 110
DATA SET: 000
A SET: 11
B SET 11

G SET: 0
CI: 00
CO: 00
MEM: 11
SPEC: SP14
TEST: BC5
NEXT: 1F

ROM WORD: 87F0F07451F

35A OIR OUTPUT IMMEDIATE, REPEAT UNTIL COMPLETE



ADDEND: 001
AUGEND: 00
ALU: 00000
SUM BUS: 110
DATA SET: 010
A SET: 11
B SET: 11

G SET: 0
CI: 01
CO: 00
MEM: 10
SPEC: 00000
TEST: BCB
NEXT: E5

ROM WORD: 2032F240BE5

ADDEND: 001
AUGEND: 00
ALU: 01100
SUM BUS: 110
DATA SET: 010
A SET: 11
B SET: 11

G SET: 0
CI: 01
CO: 00
MEM: 11
SPEC: SP0C
TEST: BC5
NEXT: 1F

ROM WORD: 2332F26C51F

ADDEND: 100
AUGEND: 00
ALU: 11111
SUM BUS: 110
DATA SET: 000
A SET: 11
B SET: 11

G SET: 0
CI: 00
CO: 00
MEM: 11
SPEC: SP14
TEST: BC5
NEXT: 1F

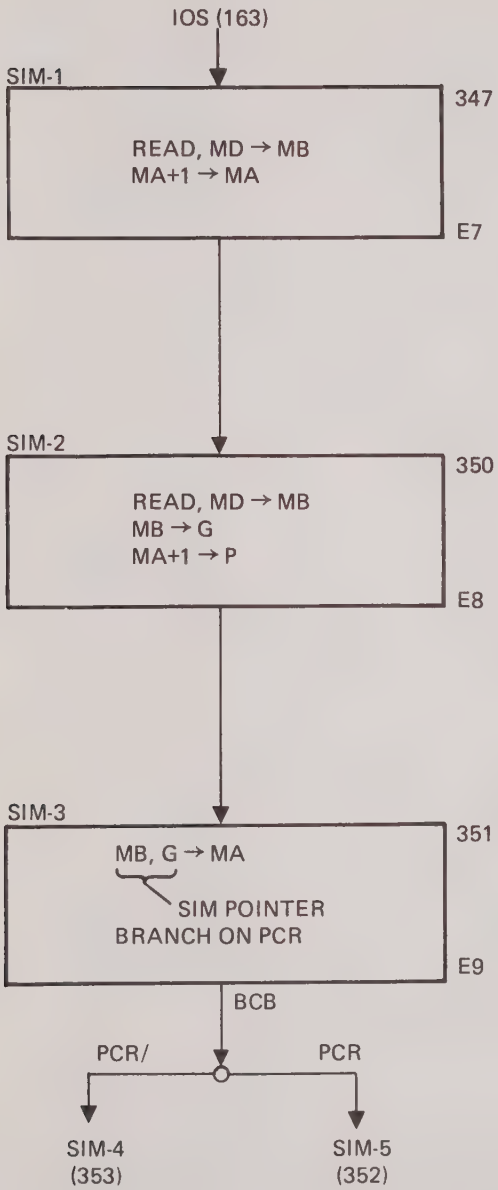
ROM WORD: 87F0F07451F

ADDEND:
AUGEND:
ALU:
SUM BUS:
DATA SET:
A SET:
B SET

G SET:
CI:
CO:
MEM:
SPEC:
TEST:
NEXT:

ROM WORD:

36A SIM SUCK INTO MEMORY



ADDEND: 000
AUGEND: 00
ALU: 00000
SUM BUS: 110
DATA SET: 001
A SET: 11
B SET: 11

G SET: 0
CI: 01
CO: 00
MEM: 10
SPEC: 00000
TEST: 0000
NEXT: E8

ROM WORD: 0031F2400E8

ADDEND: 000
AUGEND: 00
ALU: 00000
SUM BUS: 110
DATA SET: 010
A SET: 11
B SET: 11

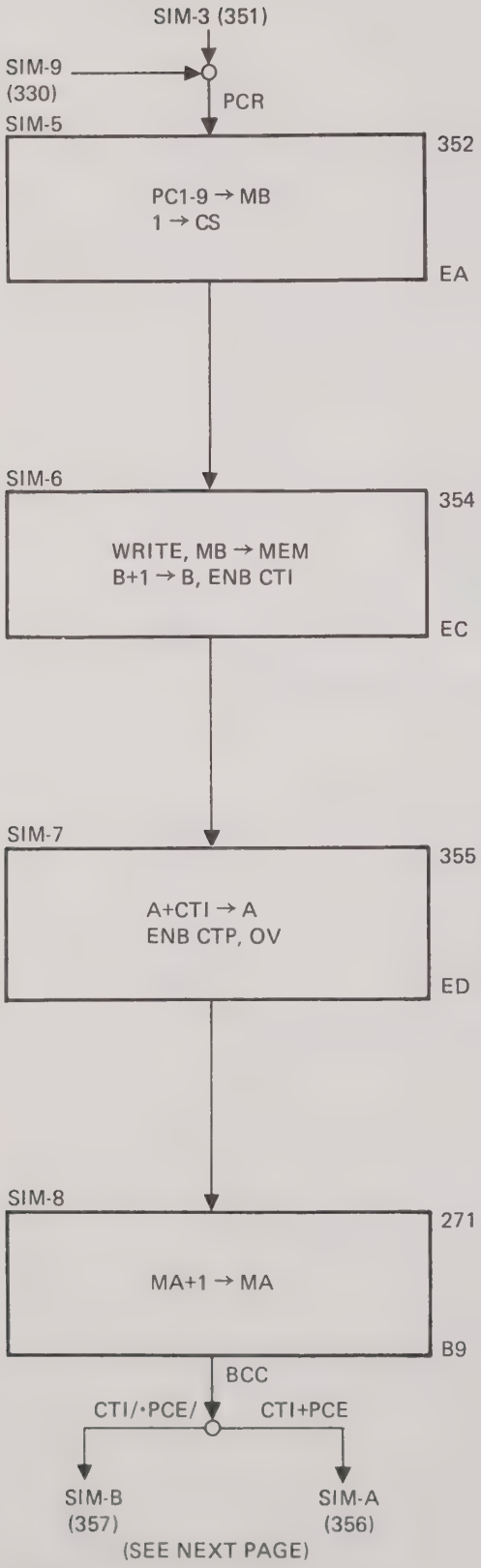
G SET: 1
CI: 01
CO: 00
MEM: 10
SPEC: 00000
TEST: 0000
NEXT: E9

ROM WORD: 0032FA400E9

ADDEND: 101
AUGEND: 00
ALU: 11111
SUM BUS: 110
DATA SET: 001
A SET: 11
B SET: 11

G SET: 0
CI: 00
CO: 00
MEM: 11
SPEC: 00000
TEST: BCB
NEXT: EB

ROM WORD: A7F1F060BEB



ADDEND: 000
AUGEND: 00
ALU: 00000
SUM BUS: 000
DATA SET: 101
A SET: 11
B SET: 11

G SET: 0
CI: 00
CO: 00
MEM: 11
SPEC: SP14
TEST: 0000
NEXT: EC

ROM WORD: 0005F0740EC

ADDEND: 111
AUGEND: 00
ALU: 00000
SUM BUS: 110
DATA SET: 000
A SET: 11
B SET: 01

G SET: 0
CI: 01
CO: 00
MEM: 01
SPEC: 00000
TEST: 0000
NEXT: ED

ROM WORD: E030D2200ED

ADDEND: 110
AUGEND: 10
ALU: 00000
SUM BUS: 110
DATA SET: 000
A SET: 01
B SET: 11

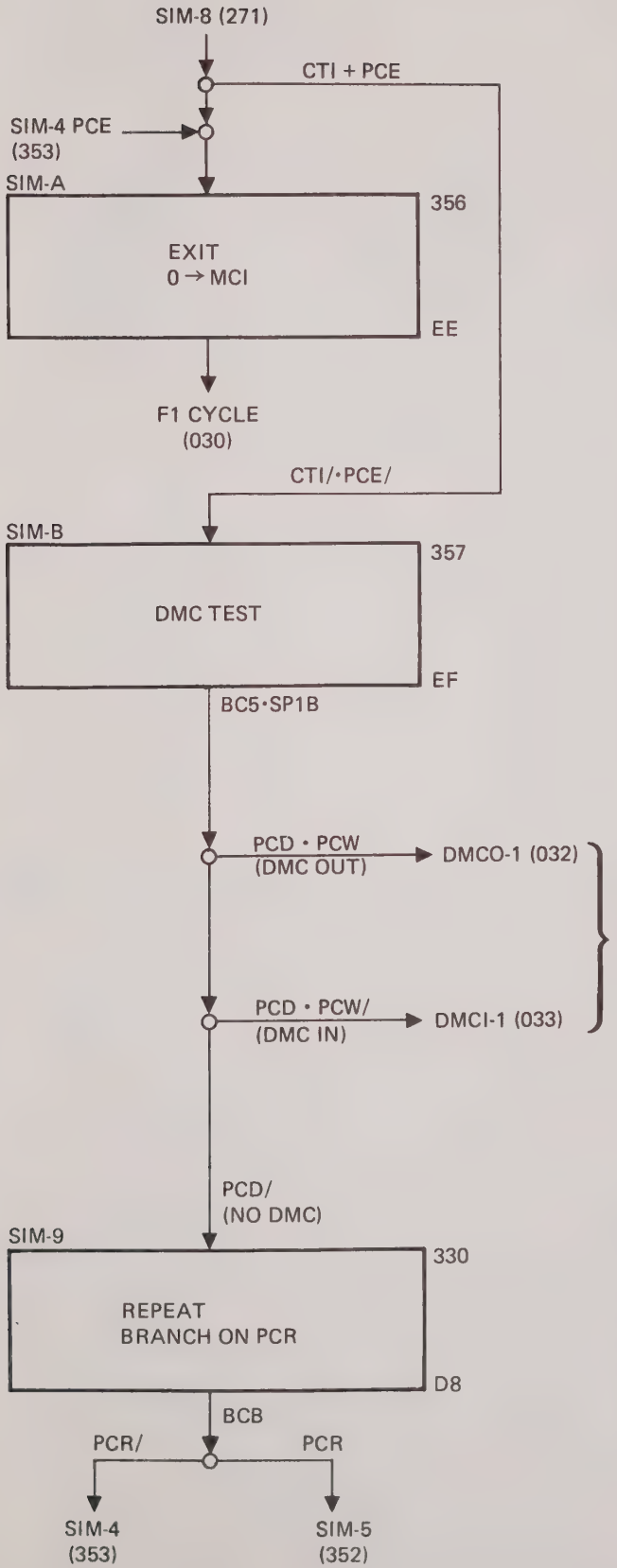
G SET: 0
CI: 11
CO: 01
MEM: 11
SPEC: 00000
TEST: 0000
NEXT: B9

ROM WORD: D03076E00B9

ADDEND: 000
AUGEND: 00
ALU: 00000
SUM BUS: 110
DATA SET: 001
A SET: 11
B SET 11

G SET: 0
CI: 01
CO: 00
MEM: 11
SPEC: 00000
TEST: BCC
NEXT: EF

ROM WORD: 0031F260CEF



ADDEND: 000
AUGEND: 00
ALU: 00000
SUM BUS: 000
DATA SET: 000
A SET: 11
B SET: 11

G SET: 0
CI: 00
CO: 00
MEM: 11
SPEC: SP1A
TEST: 0000
NEXT: 18

ROM WORD: 0000F07A018

ADDEND: 000
AUGEND: 00
ALU: 00000
SUM BUS: 000
DATA SET: 000
A SET: 11
B SET: 11

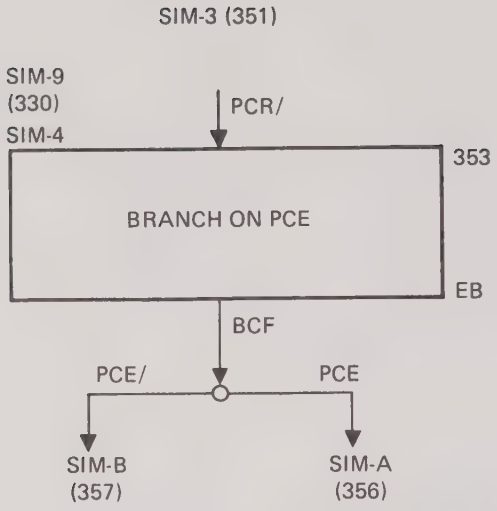
G SET: 0
CI: 00
CO: 00
MEM: 11
SPEC: SP1B
TEST: BC5
NEXT: D8

ROM WORD: 0000F07B5D8

ADDEND: 000
AUGEND: 00
ALU: 00000
SUM BUS: 00
DATA SET: 000
A SET: 11
B SET 11

G SET: 0
CI: 00
CO: 00
MEM: 11
SPEC: 00000
TEST: BCB
NEXT: D8

ROM WORD: 0000F060BEB

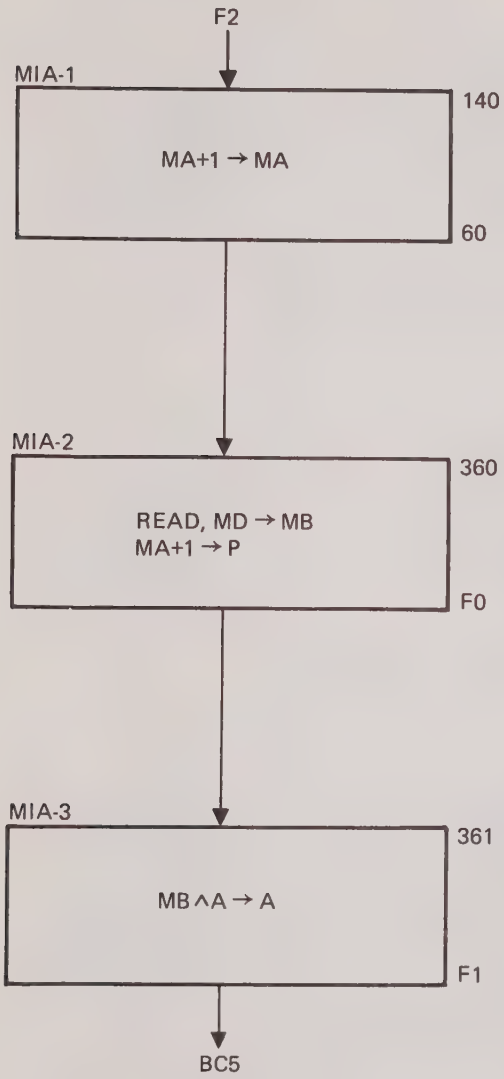


ADDEND: 000
AUGEND: 00
ALU: 00000
SUM BUS: 000
DATA SET: 000
A SET: 11
B SET: 11

G SET: 0
CI: 00
CO: 00
MEM: 11
SPEC: 0000
TEST: BCF
NEXT: EF

ROM WORD: 0000F060FEF

370 MIA MASK IMMEDIATE TO A



MIA-1

ADDEND: 000
AUGEND: 00
ALU: 00000
SUM BUS: 110
DATA SET: 001
A SET: 11
B SET: 11

G SET: 0
CI: 01
CO: 00
MEM: 11
SPEC: 00000
TEST: 0000
NEXT: F0

ROM WORD: 0031F2600F0

MIA-2

ADDEND: 000
AUGEND: 00
ALU: 00000
SUM BUS: 110
DATA SET: 010
A SET: 11
B SET: 11

G SET: 0
CI: 01
CO: 00
MEM: 10
SPEC: 00000
TEST: 0000
NEXT: F1

ROM WORD: 0032F2400F1

MIA-3

ADDEND: 110
AUGEND: 00
ALU: 10111
SUM BUS: 110
DATA SET: 000
A SET: 01
B SET: 11

G SET: 0
CI: 00
CO: 00
MEM: 11
SPEC: 00000
TEST: BC5
NEXT: 1F

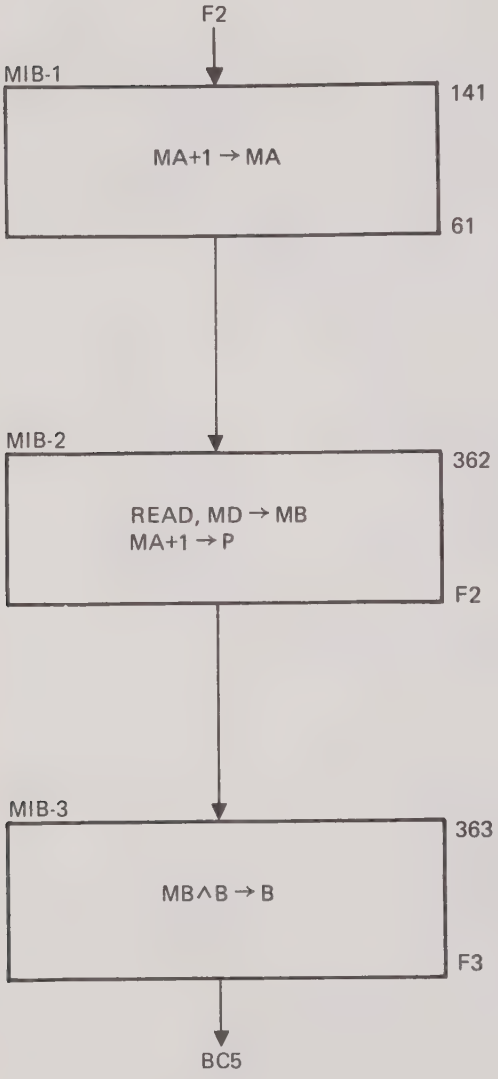
ROM WORD: C5F0706051F

ADDEND:
AUGEND:
ALU:
SUM BUS:
DATA SET:
A SET:
B SET

G SET:
CI:
CO:
MEM:
SPEC:
TEST:
NEXT:

ROM WORD:

371 MIB MASK IMMEDIATE TO B



ADDEND: 000
AUGEND: 00
ALU: 00000
SUM BUS: 110
DATA SET: 001
A SET: 11
B SET: 11

G SET: 0
CI: 01
CO: 00
MEM: 11
SPEC: 00000
TEST: 0000
NEXT: F2

ROM WORD: 0031F2600F2

ADDEND: 000
AUGEND: 00
ALU: 00000
SUM BUS: 110
DATA SET: 010
A SET: 11
B SET: 11

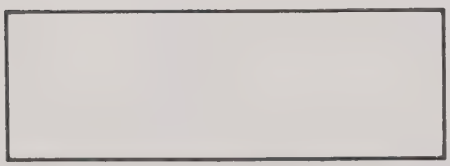
G SET: 0
CI: 01
CO: 00
MEM: 10
SPEC: 00000
TEST: 0000
NEXT: F3

ROM WORD: 0032F2400F3

ADDEND: 111
AUGEND: 00
ALU: 10111
SUM BUS: 110
DATA SET: 000
A SET: 11
B SET: 01

G SET: 0
CI: 00
CO: 00
MEM: 11
SPEC: 00000
TEST: BC5
NEXT: 1F

ROM WORD: E5F0D06051F

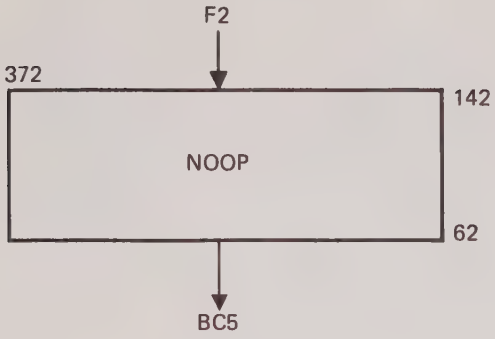


ADDEND:
AUGEND:
ALU:
SUM BUS:
DATA SET:
A SET:
B SET

G SET:
CI:
CO:
MEM:
SPEC:
TEST:
NEXT:

ROM WORD:

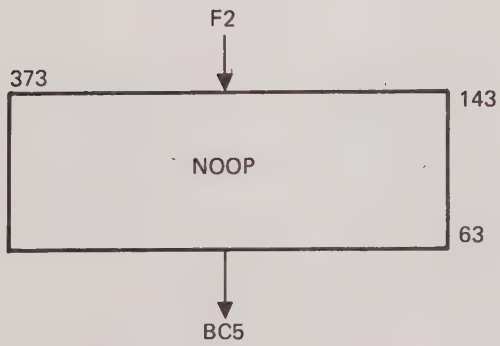
372, 373 UNUSED OP CODES



ADDEND: 000
AUGEND: 00
ALU: 00000
SUM BUS: 000
DATA SET: 000
A SET: 11
B SET: 11

G SET: 0
CI: 00
CO: 00
MEM: 11
SPEC: 00000
TEST: BC5
NEXT: 1F

ROM WORD: 0000F06051F

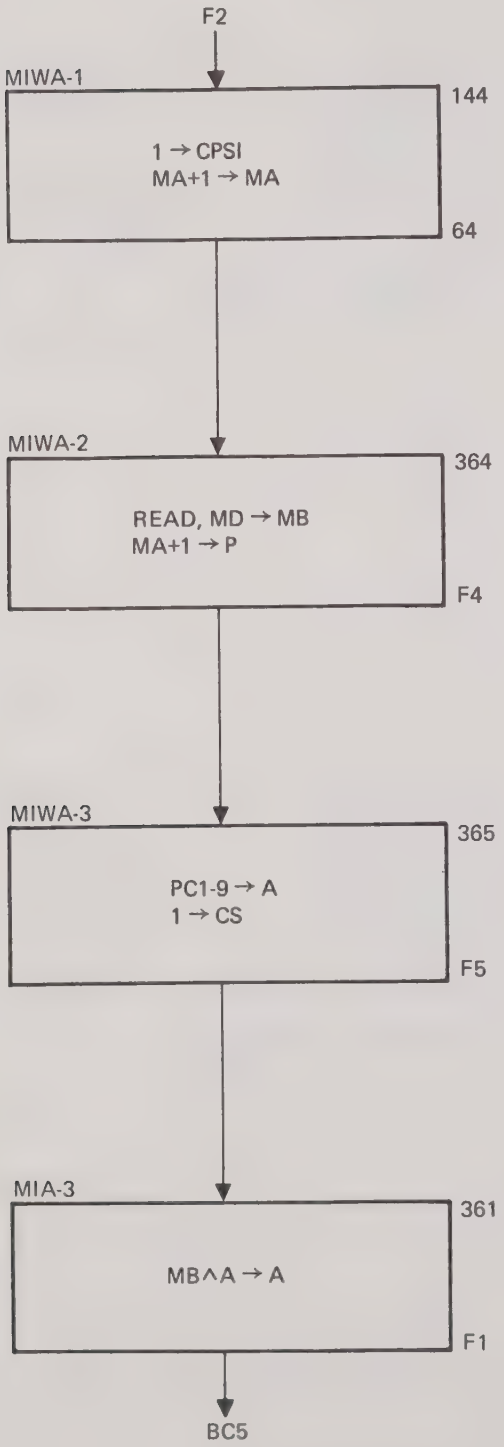


ADDEND: 000
AUGEND: 00
ALU: 00000
SUM BUS: 000
DATA SET: 000
A SET: 11
B SET: 11

G SET: 0
CI: 00
CO: 00
MEM: 11
SPEC: 00000
TEST: BC5
NEXT: 1F

ROM WORD: 0000F06051F

374 MIWA MASK INTERRUPT WORD WITH IMMEDIATE TO A



ADDEND: 000
AUGEND: 00
ALU: 00000
SUM BUS: 110
DATA SET: 001
A SET: 11
B SET: 11

G SET: 0
CI: 01
CO: 00
MEM: 11
SPEC: 00000
TEST: 0000
NEXT: F4

ROM WORD: 0031F2600F4

ADDEND: 000
AUGEND: 00
ALU: 00000
SUM BUS: 110
DATA SET: 010
A SET: 11
B SET: 11

G SET: 0
CI: 01
CO: 00
MEM: 10
SPEC: 00000
TEST: 0000
NEXT: F5

ROM WORD: 0032F2400F5

ADDEND: 000
AUGEND: 00
ALU: 00000
SUM BUS: 000
DATA SET: 000
A SET: 01
B SET: 11

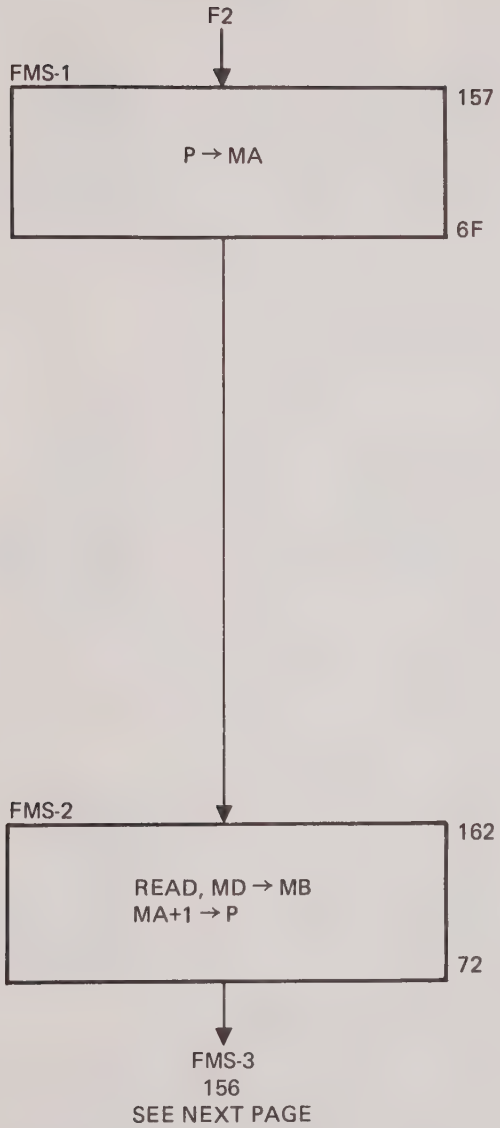
G SET: 0
CI: 00
CO: 00
MEM: 11
SPEC: SP14
TEST: 0000
NEXT: F1

ROM WORD: 000070740F1

ADDEND: 110
AUGEND: 00
ALU: 10111
SUM BUS: 110
DATA SET: 000
A SET: 01
B SET 11

G SET: 0
CI: 00
CO: 00
MEM: 11
SPEC: 00000
TEST: BC5
NEXT: 1F

ROM WORD: C5F0706051F



ADDEND: 001
AUGEND: 00
ALU: 11111
SUM BUS: 110
DATA SET: 001
A SET: 11
B SET: 11

G SET: 0
CI: 00
CO: 00
MEM: 11
SPEC: 00000
TEST: 0000
NEXT: 72

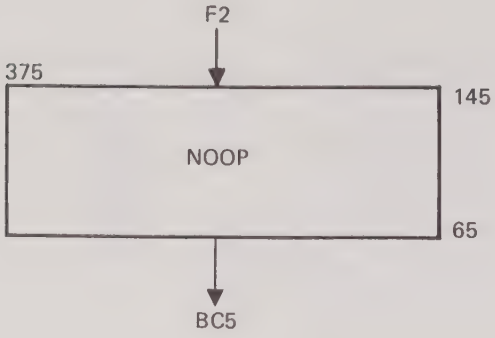
ROM WORD: 27F1F060072

ADDEND: 000
AUGEND: 00
ALU: 00000
SUM BUS: 110
DATA SET: 010
A SET: 11
B SET: 11

G SET: 0
CI: 01
CO: 00
MEM: 10
SPEC: 00000
TEST: 0000
NEXT: 6E

ROM WORD: 0032F24006E

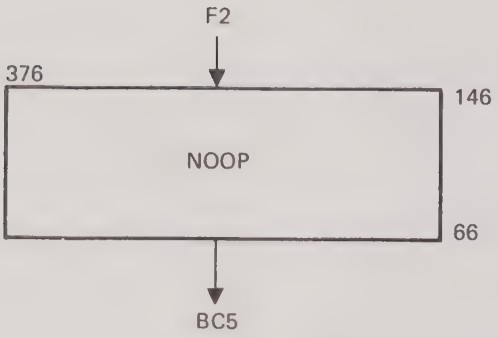
375, 376, 377 UNUSED OP CODES



ADDEND: 000
AUGEND: 00
ALU: 00000
SUM BUS: 000
DATA SET: 000
A SET: 11
B SET: 11

G SET: 0
CI: 00
CO: 00
MEM: 11
SPEC: 00000
TEST: BC5
NEXT: 1F

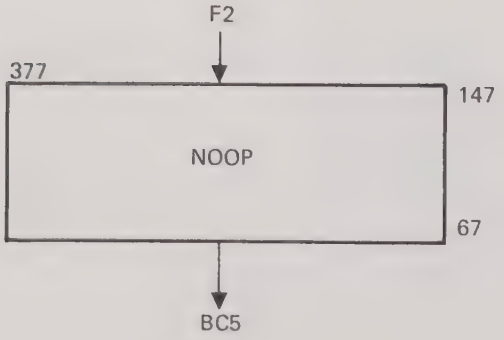
ROM WORD: 0000F06051F



ADDEND: 000
AUGEND: 00
ALU: 00000
SUM BUS: 000
DATA SET: 000
A SET: 11
B SET: 11

G SET: 0
CI: 00
CO: 00
MEM: 11
SPEC: 00000
TEST: BC5
NEXT: 1F

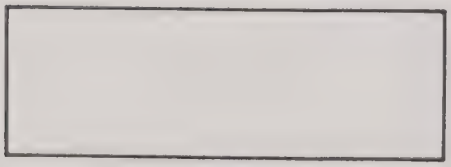
ROM WORD: 0000F06051F



ADDEND: 000
AUGEND: 00
ALU: 00000
SUM BUS: 000
DATA SET: 000
A SET: 11
B SET: 11

G SET: 0
CI: 00
CO: 00
MEM: 11
SPEC: 00000
TEST: BC5
NEXT: 1F

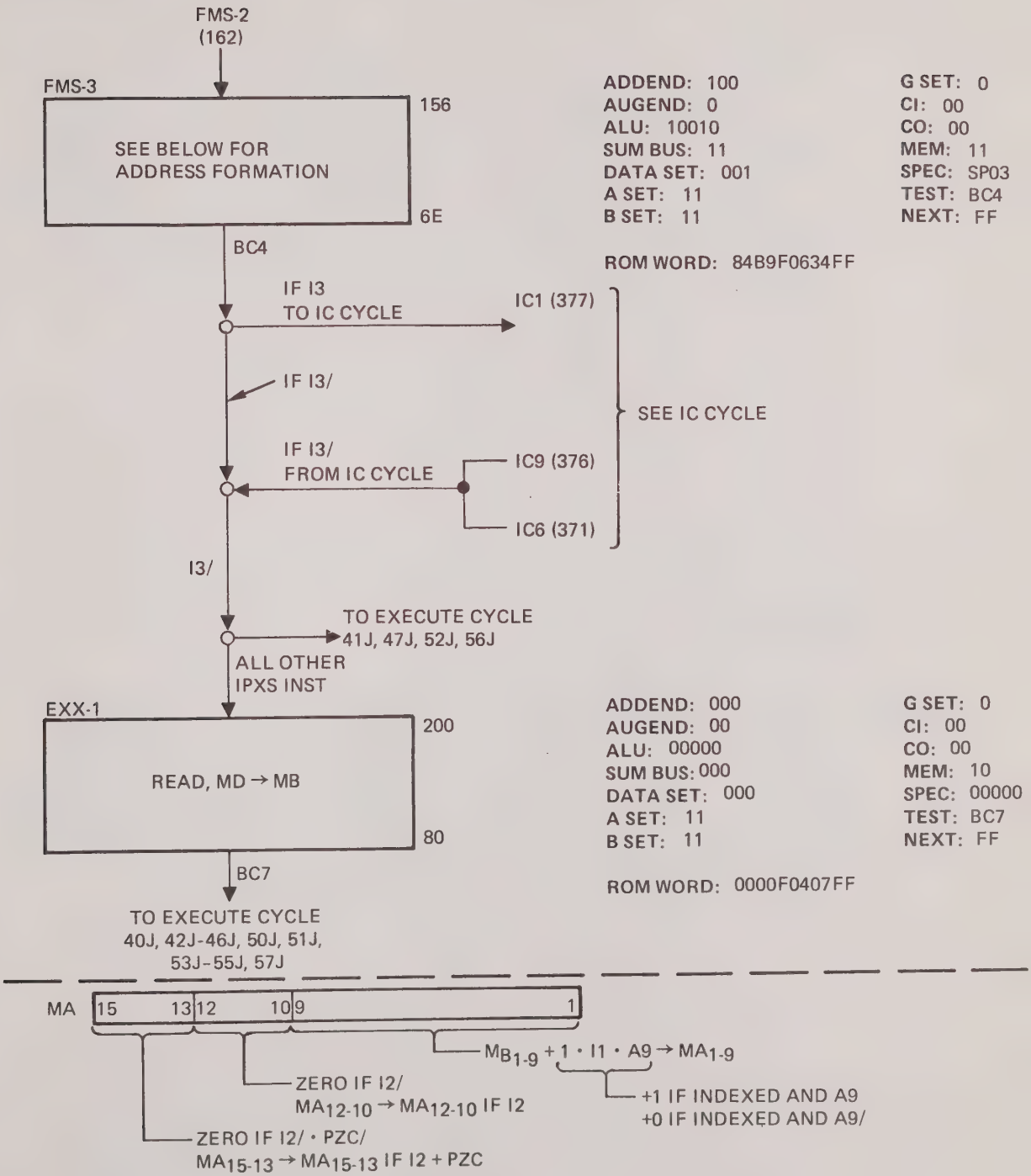
ROM WORD: 0000F06051F



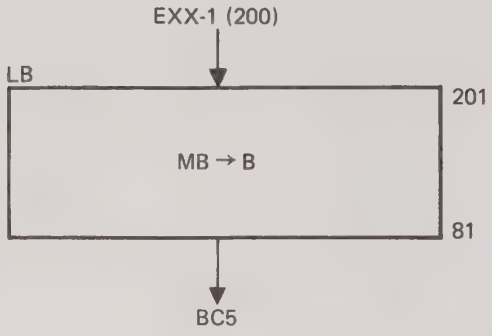
ADDEND:
AUGEND:
ALU:
SUM BUS:
DATA SET:
A SET:
B SET

G SET:
CI:
CO:
MEM:
SPEC:
TEST:
NEXT:

ROM WORD:


FMS-2
(162)
FMS-3
156
SEE BELOW FOR
ADDRESS FORMATION
6E
ADDEND: 100
AUGEND: 0
ALU: 10010
SUM BUS: 11
DATA SET: 001
A SET: 11
B SET: 11
G SET: 0
CI: 00
CO: 00
MEM: 11
SPEC: SP03
TEST: BC4
NEXT: FF
ROM WORD: 84B9F0634FF
BC4
IF I3
TO IC CYCLE
IC1 (377)
IF I3/
IF I3/
FROM IC CYCLE
IC9 (376)
IC6 (371)
SEE IC CYCLE
I3/
TO EXECUTE CYCLE
41J, 47J, 52J, 56J
ALL OTHER
IPXS INST
EXX-1
200
READ, MD → MB
80
ADDEND: 000
AUGEND: 00
ALU: 00000
SUM BUS: 000
DATA SET: 000
A SET: 11
B SET: 11
G SET: 0
CI: 00
CO: 00
MEM: 10
SPEC: 00000
TEST: BC7
NEXT: FF
ROM WORD: 0000F0407FF
BC7
TO EXECUTE CYCLE
40J, 42J-46J, 50J, 51J,
53J-55J, 57J
MA
15
13
12
10
9
1
MB1-9 + 1 · I1 · A9 → MA1-9
ZERO IF I2/
MA12-10 → MA12-10 IF I2
+1 IF INDEXED AND A9
+0 IF INDEXED AND A9/
ZERO IF I2/ · PZC/
MA15-13 → MA15-13 IF I2 + PZC

40J LB LOAD B FROM MEMORY

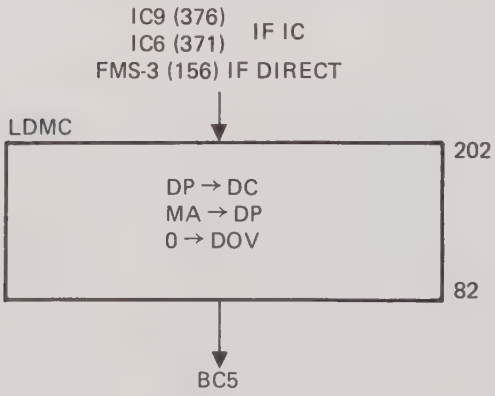


ADDEND: 100
AUGEND: 00
ALU: 11111
SUM BUS: 110
DATA SET: 000
A SET: 11
B SET: 01

G SET: 0
CI: 00
CO: 00
MEM: 11
SPEC: 00000
TEST: BC5
NEXT: 1F

ROM WORD: 87F0D06051F

41J LDMC LOAD DMC REGISTERS

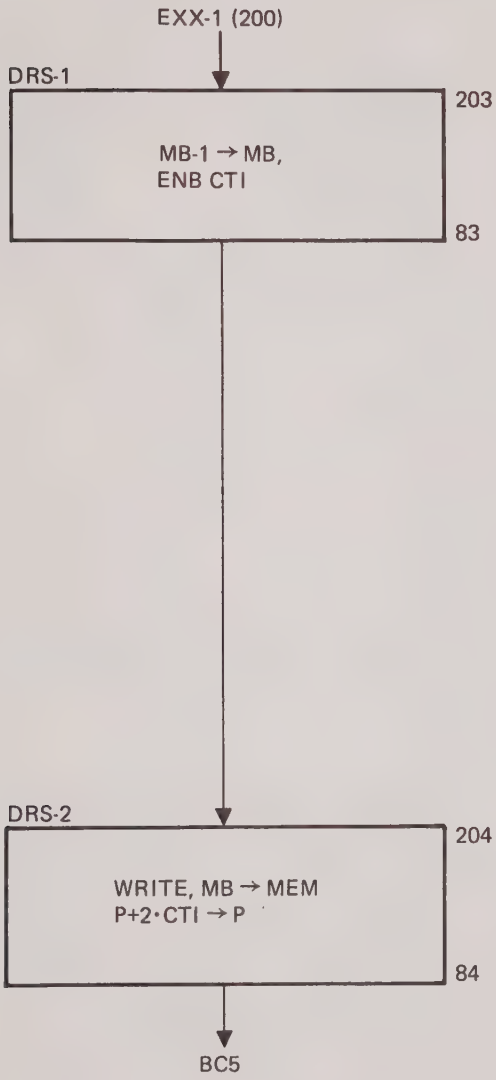


ADDEND: 011
AUGEND: 00
ALU: 11111
SUM BUS: 110
DATA SET: 110
A SET: 11
B SET: 11

G SET: 0
CI: 00
CO: 00
MEM: 11
SPEC: 00000
TEST: BC5
NEXT: 1F

ROM WORD: 67F6F06051F

42J DRS DECREMENT MEMORY ONE, SKIP IF OV



ADDEND: 100
AUGEND: 00
ALU: 11110
SUM BUS: 110
DATA SET: 101
A SET: 11
B SET: 11

G SET: 0
CI: 00
CO: 00
MEM: 11
SPEC: SP0D
TEST: 0000
NEXT: 84

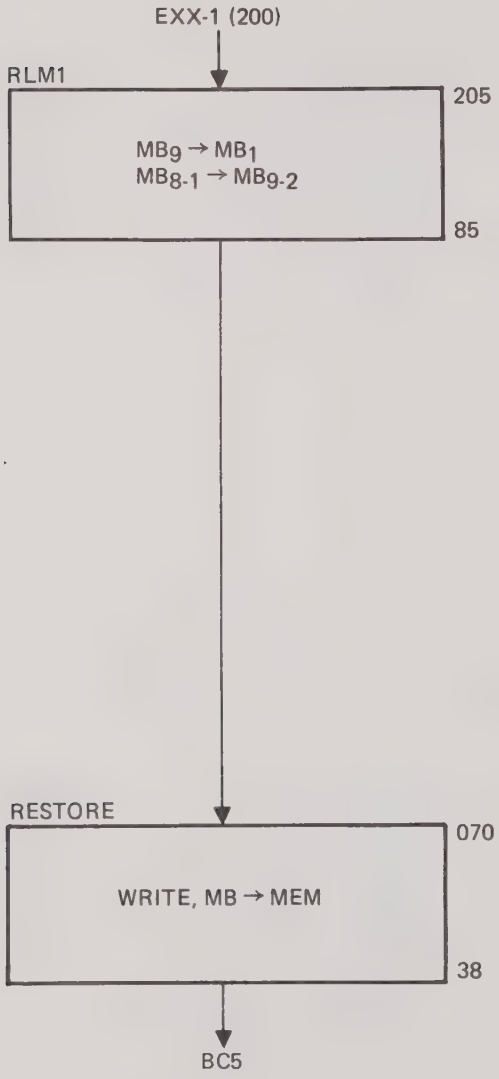
ROM WORD: 87B5F06D084

ADDEND: 001
AUGEND: 00
ALU: 10010
SUM BUS: 110
DATA SET: 010
A SET: 11
B SET: 11

G SET: 0
CI: 00
CO: 00
MEM: 01
SPEC: SP04
TEST: BC5
NEXT: 1F

ROM WORD: 24B2F02451F

43J RLM-1 ROTATE LEFT MEMORY ONE BIT



ADDEND: 100
AUGEND: 00
ALU: 11111
SUM BUS: 100
DATA SET: 101
A SET: 11
B SET: 11

G SET: 0
CI: 00
CO: 00
MEM: 11
SPEC: 00000
TEST: 0000
NEXT: 38

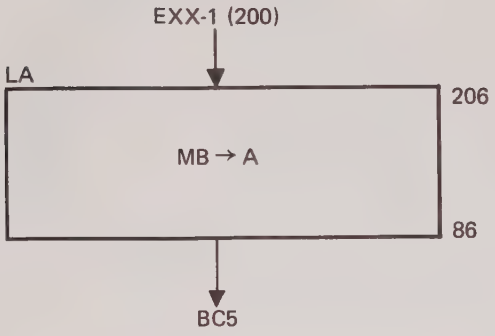
ROM WORD: 87E5F060038

ADDEND: 000
AUGEND: 00
ALU: 00000
SUM BUS: 000
DATA SET: 000
A SET: 11
B SET: 11

G SET: 0
CI: 00
CO: 00
MEM: 01
SPEC: 00000
TEST: BC5
NEXT: 1F

ROM WORD: 0000F02051F

44J LA LOAD A FROM MEMORY

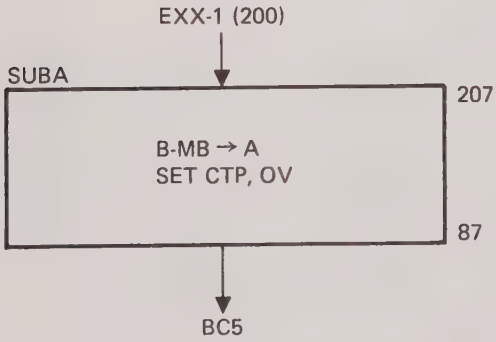


ADDEND: 100
AUGEND: 00
ALU: 11111
SUM BUS: 110
DATA SET: 000
A SET: 01
B SET: 11

G SET: 0
CI: 00
CO: 00
MEM: 11
SPEC: 00000
TEST: BC5
NEXT: 1F

ROM WORD: 87F0706051F

45J SUBA SUBTRACT MEMORY FROM B, RESULT IN A



ADDEND: 111
AUGEND: 00
ALU: 01100
SUM BUS: 110
DATA SET: 000
A SET: 01
B SET: 11

G SET: 0
CI: 01
CO: 01
MEM: 11
SPEC: 00000
TEST: BC5
NEXT: 1F

ROM WORD: E33072E051F

46J IRS INCREMENT MEMORY ONE, SKIP IF OV

ADDEND: 100
AUGEND: 00
ALU: 00000
SUM BUS: 110
DATA SET: 101
A SET: 11
B SET: 11

G SET: 0
CI: 01
CO: 00
MEM: 11
SPEC: SP0D
TEST: 0000
NEXT: 84

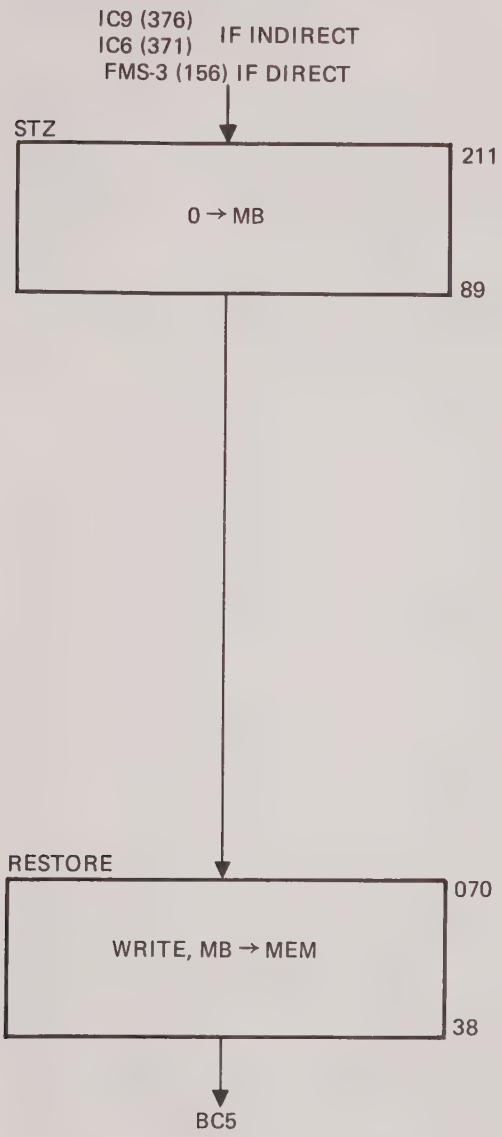
ROM WORD: 8035F26D084

ADDEND: 001
AUGEND: 00
ALU: 10010
SUM BUS: 110
DATA SET: 010
A SET: 11
B SET: 11

G SET: 0
CI: 00
CO: 00
MEM: 01
SPEC: 0100
TEST: BC5
NEXT: 1F

ROM WORD: 24B2F02451F

47J STZ STORE ZERO IN MEMORY



ADDEND: 000
AUGEND: 00
ALU: 00111
SUM BUS: 110
DATA SET: 101
A SET: 11
B SET: 11

G SET: 0
CI: 00
CO: 00
MEM: 11
SPEC: 00000
TEST: 0000
NEXT: 38

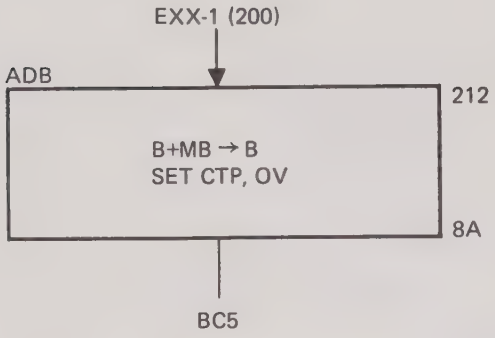
ROM WORD: 01F5F060038

ADDEND: 000
AUGEND: 00
ALU: 00000
SUM BUS: 000
DATA SET: 000
A SET: 11
B SET: 11

G SET: 0
CI: 00
CO: 00
MEM: 01
SPEC:
TEST: BC5
NEXT: 1F

ROM WORD: 0000F02051F

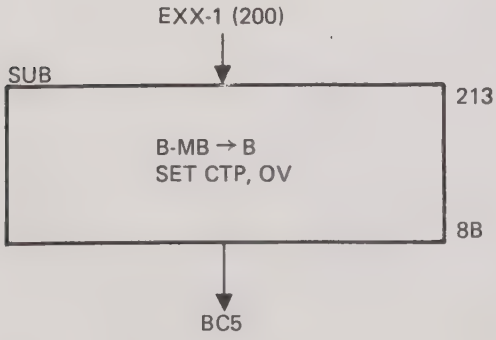
50J ADB ADD MEMORY TO B



ADDEND: 111	G SET: 0
AUGEND: 00	CI: 00
ALU: 10010	CO: 01
SUM BUS: 110	MEM: 11
DATA SET: 000	SPEC: 00000
A SET: 11	TEST: BC5
B SET: 01	NEXT: 1F

ROM WORD: E4B0D0E051F

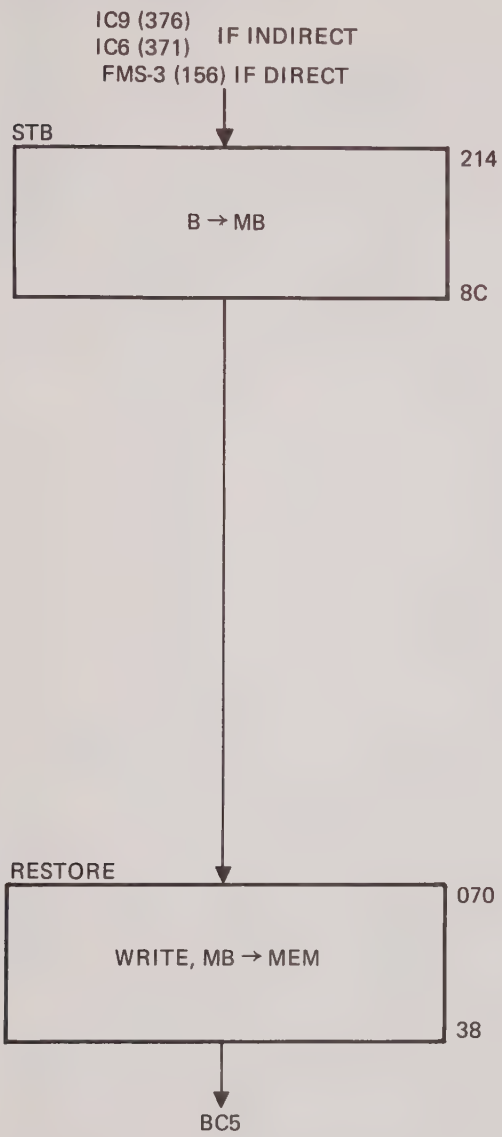
51J SUB SUBTRACT MEMORY FROM B



ADDEND: 111	G SET: 0
AUGEND: 00	CI: 01
ALU: 01100	CO: 01
SUM BUS: 110	MEM: 11
DATA SET: 000	SPEC: 00000
A SET: 11	TEST: BC5
B SET: 01	NEXT: 1F

ROM WORD: E330D2E051F

52J STB STORE B IN MEMORY



ADDEND:
AUGEND:
ALU:
SUM BUS:
DATA SET:
A SET:
B SET:

G SET:
CI:
CO:
MEM:
SPEC:
TEST:
NEXT:

ROM WORD: E035F060038

ADDEND: 000
AUGEND: 00
ALU: 00000
SUM BUS: 000
DATA SET: 000
A SET: 11
B SET: 11

G SET: 0
CI: 00
CO: 00
MEM: 11
SPEC: 00000
TEST: BC5
NEXT: 51F

ROM WORD: 0000F02051F

53J XMB EXCHANGE MEMORY AND B

ADDEND: 111
AUGEND: 00
ALU: 11111
SUM BUS: 110
DATA SET: 101
A SET: 11
B SET: 11

G SET: 1
CI: 00
CO: 00
MEM: 11
SPEC: 00000
TEST: 0000
NEXT: A2

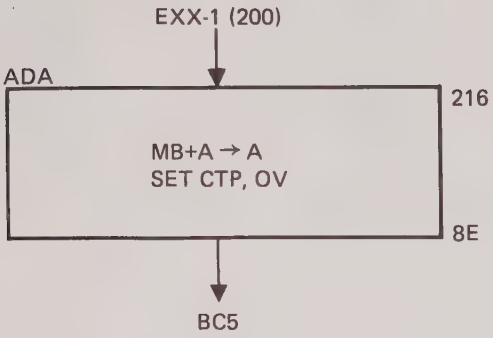
ROM WORD: E7F5F8600A2

ADDEND: 000
AUGEND: 01
ALU: 10101
SUM BUS: 110
DATA SET: 000
A SET: 11
B SET: 01

G SET: 0
CI: 00
CO: 00
MEM: 01
SPEC: 00000
TEST: BC5
NEXT: 1F

ROM WORD: 0D70D02051F

54J ADA ADD MEMORY TO A

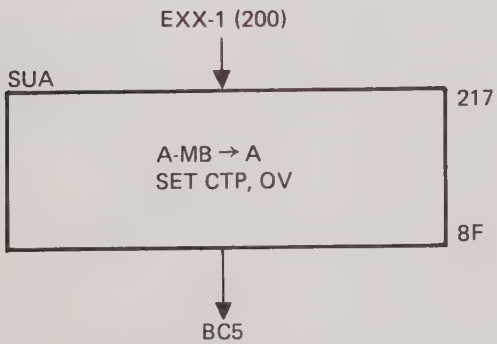


ADDEND: 110
AUGEND: 00
ALU: 10010
SUM BUS: 110
DATA SET: 000
A SET: 01
B SET: 11

G SET: 0
CI: 00
CO: 01
MEM: 11
SPEC: 00000
TEST: BC5
NEXT: 1F

ROM WORD: C4B070E051F

55J SUA SUBTRACT MEMORY FROM A

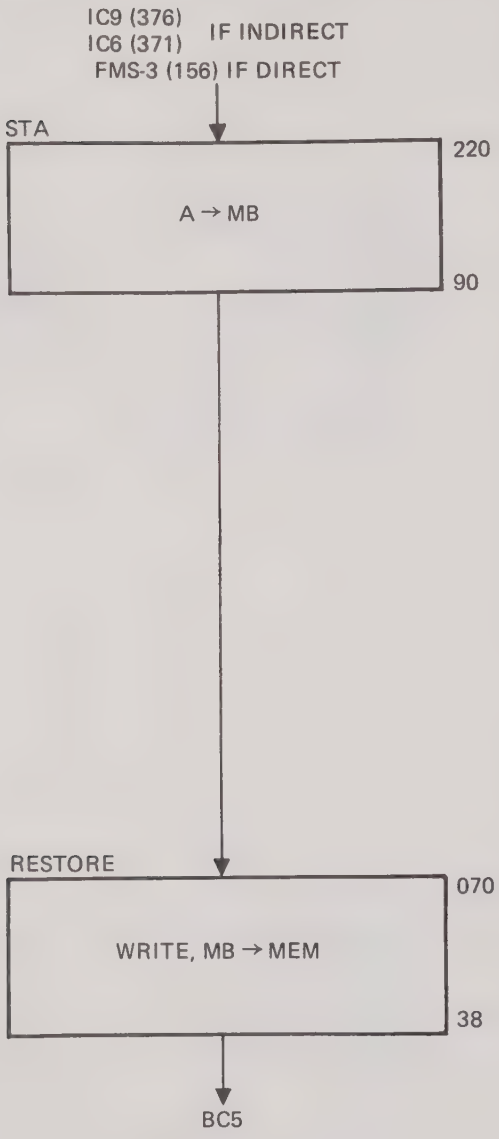


ADDEND: 110
AUGEND: 00
ALU: 01100
SUM BUS: 110
DATA SET: 000
A SET: 01
B SET: 11

G SET: 0
CI: 01
CO: 01
MEM: 11
SPEC: 00000
TEST: BC5
NEXT: 1F

ROM WORD: C33072E051F

56J STA STORE A IN MEMORY



ADDEND: 110
AUGEND: 00
ALU: 11111
SUM BUS: 110
DATA SET: 101
A SET: 11
B SET: 11

G SET: 0
CI: 00
CO: 00
MEM: 11
SPEC: 00000
TEST: 0000
NEXT: 38

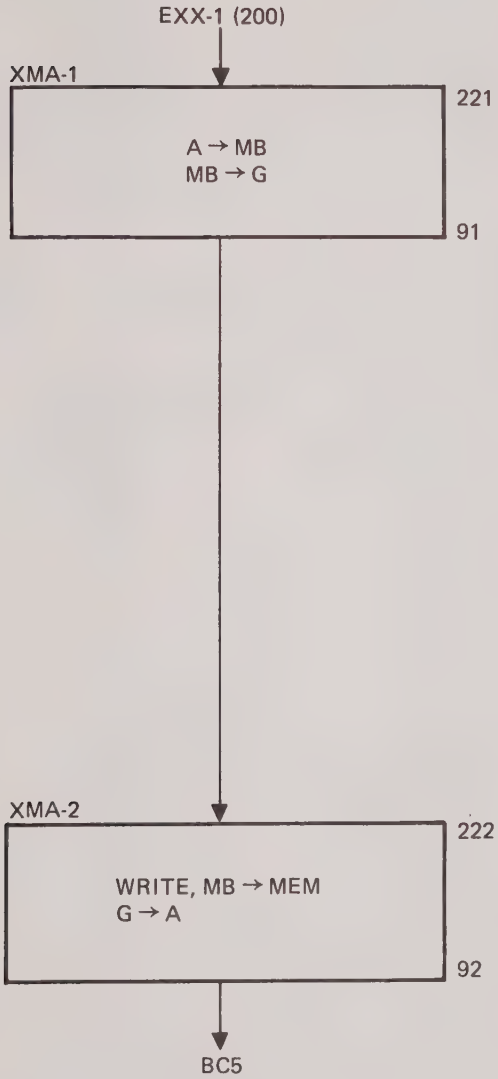
ROM WORD: C7F5F060038

ADDEND: 000
AUGEND: 00
ALU: 00000
SUM BUS: 000
DATA SET: 000
A SET: 11
B SET: 11

G SET: 0
CI: 00
CO: 00
MEM: 11
SPEC: 00000
TEST: BC5
NEXT: 1F

ROM WORD: 0000F02051F

57J XMA EXCHANGE MEMORY AND A



XMA-1

ADDEND: 110
AUGEND: 00
ALU: 11111
SUM BUS: 110
DATA SET: 101
A SET: 11
B SET: 11

G SET: 1
CI: 00
CO: 00
MEM: 11
SPEC: 00000
TEST: 0000
NEXT: 92

ROM WORD: C7F5F860092

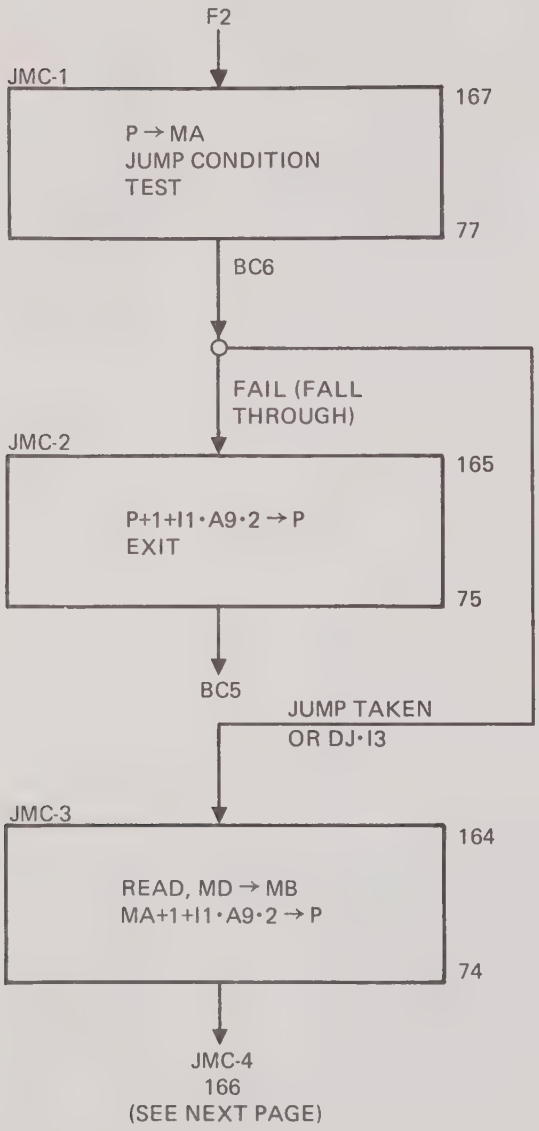
XMA-2

ADDEND: 000
AUGEND: 01
ALU: 10101
SUM BUS: 110
DATA SET: 000
A SET: 01
B SET: 11

G SET: 0
CI: 00
CO: 00
MEM: 01
SPEC: 00000
TEST: BC5
NEXT: 1F

ROM WORD: 0D70702051F

60J-77J JUMP INSTRUCTIONS



ADDEND: 001
AUGEND: 00
ALU: 11111
SUM BUS: 110
DATA SET: 001
A SET: 11
B SET: 11

G SET: 0
CI: 00
CO: 00
MEM: 11
SPEC: 00000
TEST: BC6
NEXT: 75

ROM WORD: 27F1F060675

ADDEND: 001
AUGEND: 00
ALU: 10010
SUM BUS: 110
DATA SET: 010
A SET: 11
B SET: 11

G SET: 0
CI: 01
CO: 00
MEM: 11
SPEC: SP05
TEST: BC5
NEXT: 1F

ROM WORD: 24B2F26551F

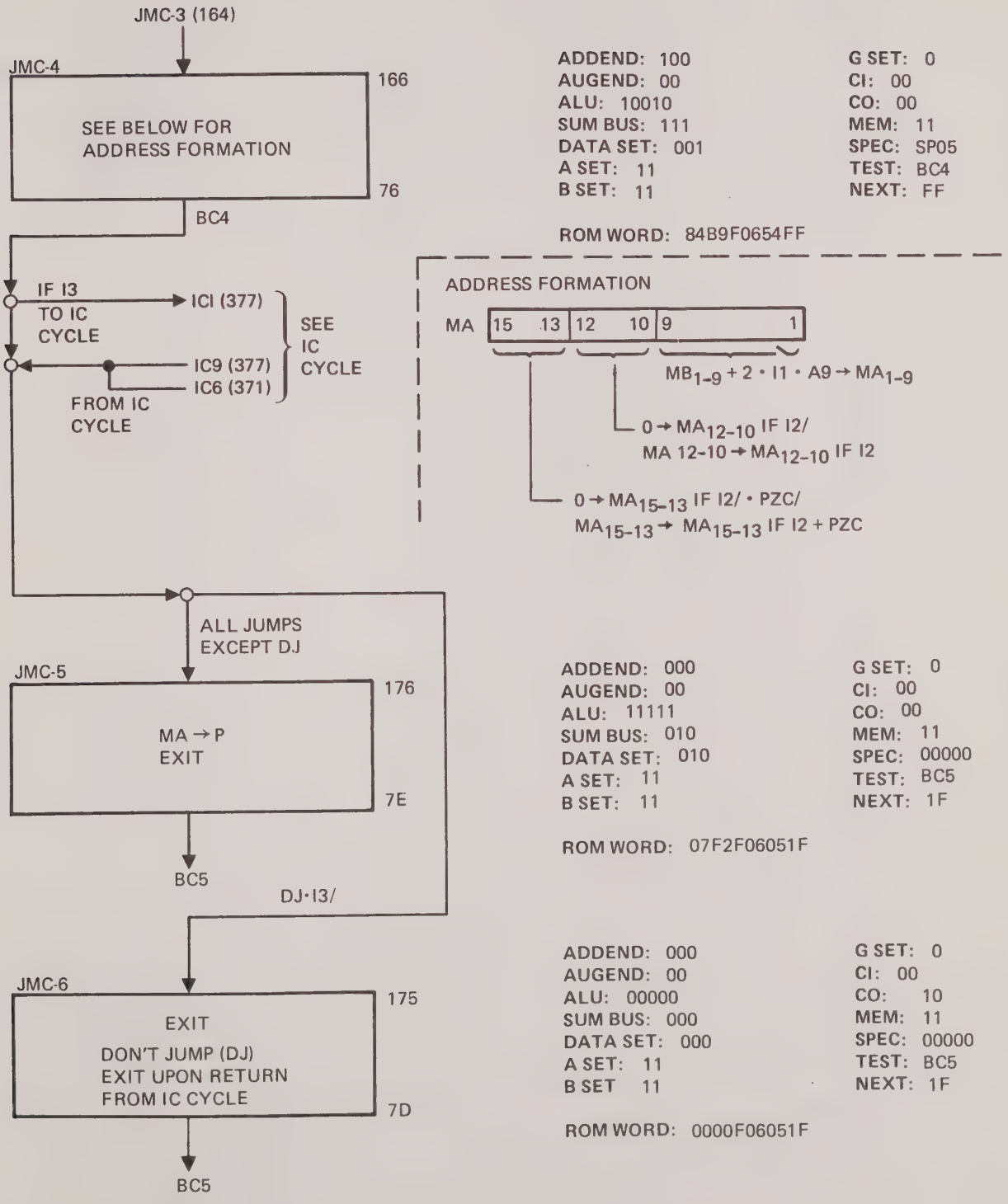
ADDEND: 001
AUGEND: 00
ALU: 10010
SUM BUS: 110
DATA SET: 010
A SET: 11
B SET: 11

G SET: 0
CI: 01
CO: 00
MEM: 10
SPEC: SP05
TEST: 0000
NEXT: 76

ROM WORD: 24B2F245076

JUMP CONDITIONS:

60J	DONT JUMP	70J	A = 0
61J	JUMP UNCOND'NL	71J	A ≠ 0
62J	OV	72J	B1 (AB ODD)
63J	OV/	73J	B1/ (AB EVEN)
64J	A9 (A = -)	74J	AB = 0
65J	A9/ (A = +)	75J	AB ≠ 0
66J	A1 (A = ODD)	76J	CTP
67J	A1/ (A = EVEN)	77J	CTP/



ADDEND: 100
AUGEND: 00
ALU: 10010
SUM BUS: 111
DATA SET: 001
A SET: 11
B SET: 11

G SET: 0
CI: 00
CO: 00
MEM: 11
SPEC: SP05
TEST: BC4
NEXT: FF

ROM WORD: 84B9F0654FF

ADDEND: 000
AUGEND: 00
ALU: 11111
SUM BUS: 010
DATA SET: 010
A SET: 11
B SET: 11

G SET: 0
CI: 00
CO: 00
MEM: 11
SPEC: 00000
TEST: BC5
NEXT: 1F

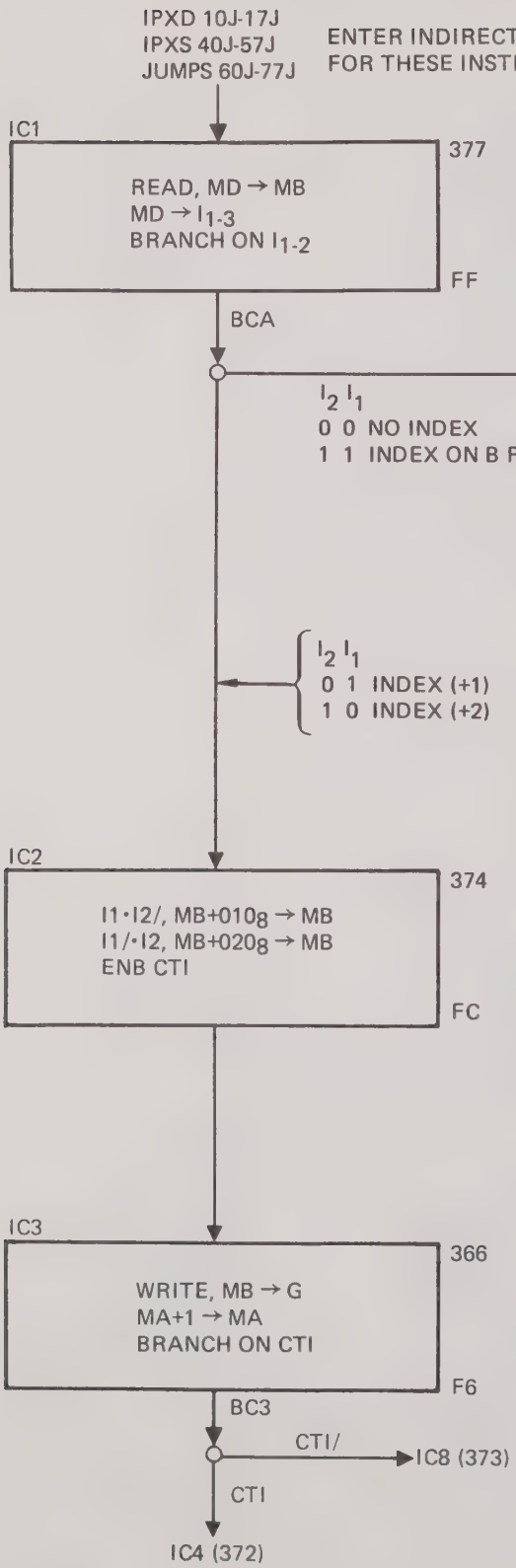
ROM WORD: 07F2F06051F

ADDEND: 000
AUGEND: 00
ALU: 00000
SUM BUS: 000
DATA SET: 000
A SET: 11
B SET 11

G SET: 0
CI: 00
CO: 10
MEM: 11
SPEC: 00000
TEST: BC5
NEXT: 1F

ROM WORD: 0000F06051F

INDIRECT CYCLE (IC)



ADDEND: 000
AUGEND: 00
ALU: 00000
SUM BUS: 000
DATA SET: 000
A SET: 11
B SET: 11

G SET: 0
CI: 00
CO: 00
MEM: 10
SPEC: SP02
TEST: BCA
NEXT: FD

ROM WORD: 0000F042AFD

ADDEND: 100
AUGEND: 00
ALU: 10010
SUM BUS: 110
DATA SET: 101
A SET: 11
B SET: 11

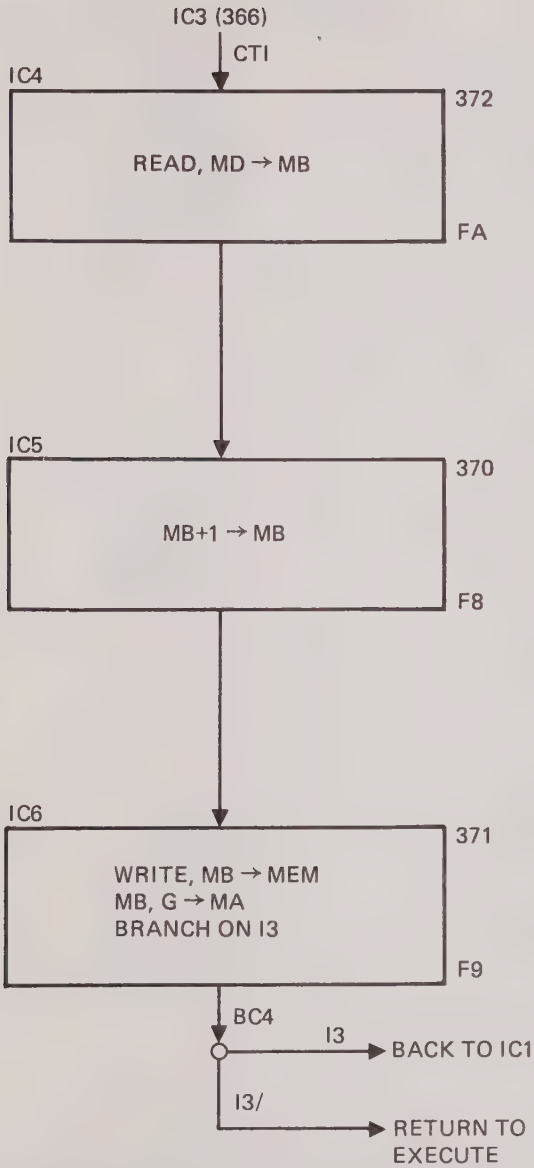
G SET: 0
CI: 00
CO: 00
MEM: 11
SPEC: SP07
TEST: 0000
NEXT: F6

ROM WORD: 84B5F0670F6

ADDEND: 000
AUGEND: 00
ALU: 00000
SUM BUS: 110
DATA SET: 001
A SET: 11
B SET 11

G SET: 1
CI: 01
CO: 11
MEM: 01
SPEC: 00000
TEST: BC3
NEXT: FB

ROM WORD: 0031FBA03FB



ADDEND: 000
AUGEND: 00
ALU: 00000
SUM BUS: 000
DATA SET: 000
A SET: 11
B SET: 11

G SET: 0
CI: 00
CO: 00
MEM: 10
SPEC: 00000
TEST: 0000
NEXT: F8

ROM WORD: 0000F0400F8

ADDEND: 100
AUGEND: 00
ALU: 00000
SUM BUS: 110
DATA SET: 101
A SET: 11
B SET: 11

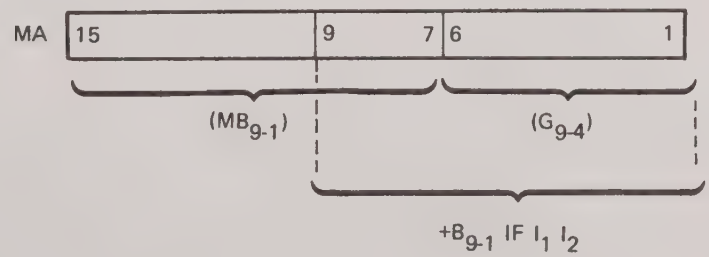
G SET: 0
CI: 01
CO: 00
MEM: 11
SPEC: 00000
TEST: 0000
NEXT: F9

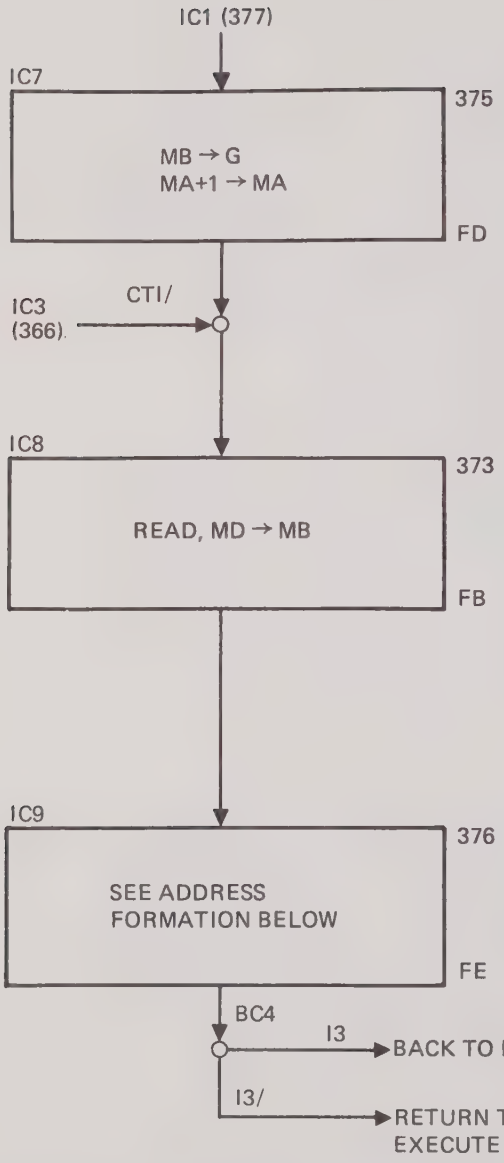
ROM WORD: 8035F2600F9

ADDEND: 101
AUGEND: 00
ALU: 11111
SUM BUS: 110
DATA SET: 001
A SET: 11
B SET: 11

G SET: 0
CI: 00
CO: 00
MEM: 01
SPEC: 00000
TEST: BC4
NEXT: FF

ROM WORD: A7F1F0204FF





ADDEND: 000
AUGEND: 00
ALU: 00000
SUM BUS: 110
DATA SET: 001
A SET: 11
B SET: 11

G SET: 1
CI: 01
CO: 00
MEM: 11
SPEC: 0000
TEST: 0000
NEXT: FB

ROM WORD: 0031FA600FB

ADDEND: 000
AUGEND: 00
ALU: 00000
SUM BUS: 000
DATA SET: 000
A SET: 11
B SET: 11

G SET: 0
CI: 00
CO: 00
MEM: 10
SPEC: 00000
TEST: 0000
NEXT: FE

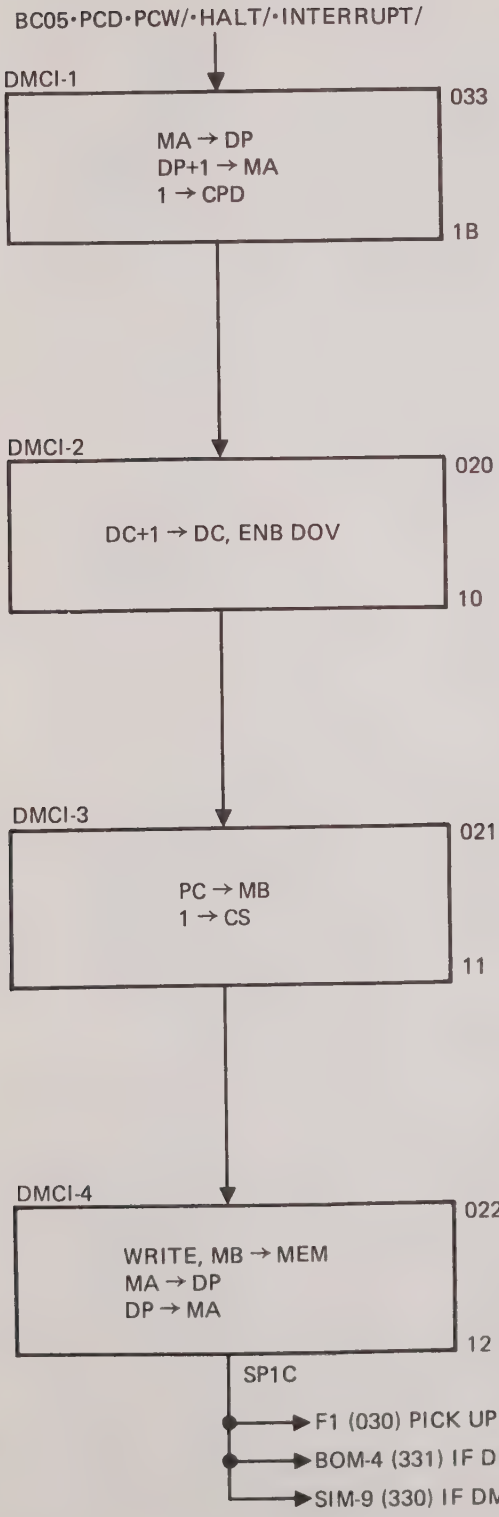
ROM WORD: 0000F0400FE

ADDEND: 101
AUGEND: 11
ALU: 10010
SUM BUS: 110
DATA SET: 001
A SET: 11
B SET: 11

G SET: 0
CI: 00
CO: 00
MEM: 11
SPEC: SP08
TEST: BC4
NEXT: FF

ROM WORD: BCB1F0684FF

DMC INPUT CYCLE



ADDEND: 011
AUGEND: 00
ALU: 00000
SUM BUS: 110
DATA SET: 111
A SET: 11
B SET: 11

G SET: 0
CI: 01
CO: 00
MEM: 11
SPEC: SP13
TEST: 0000
NEXT: 10

ROM WORD: 6037F273010

ADDEND: 010
AUGEND: 00
ALU: 00000
SUM BUS: 110
DATA SET: 011
A SET: 11
B SET: 11

G SET: 0
CI: 01
CO: 00
MEM: 11
SPEC: SP16
TEST: 0000
NEXT: 11

ROM WORD: 4033F276011

ADDEND: 000
AUGEND: 00
ALU: 00000
SUM BUS: 000
DATA SET: 101
A SET: 11
B SET: 11

G SET: 0
CI: 00
CO: 00
MEM: 11
SPEC: SP14
TEST: 0000
NEXT: 12

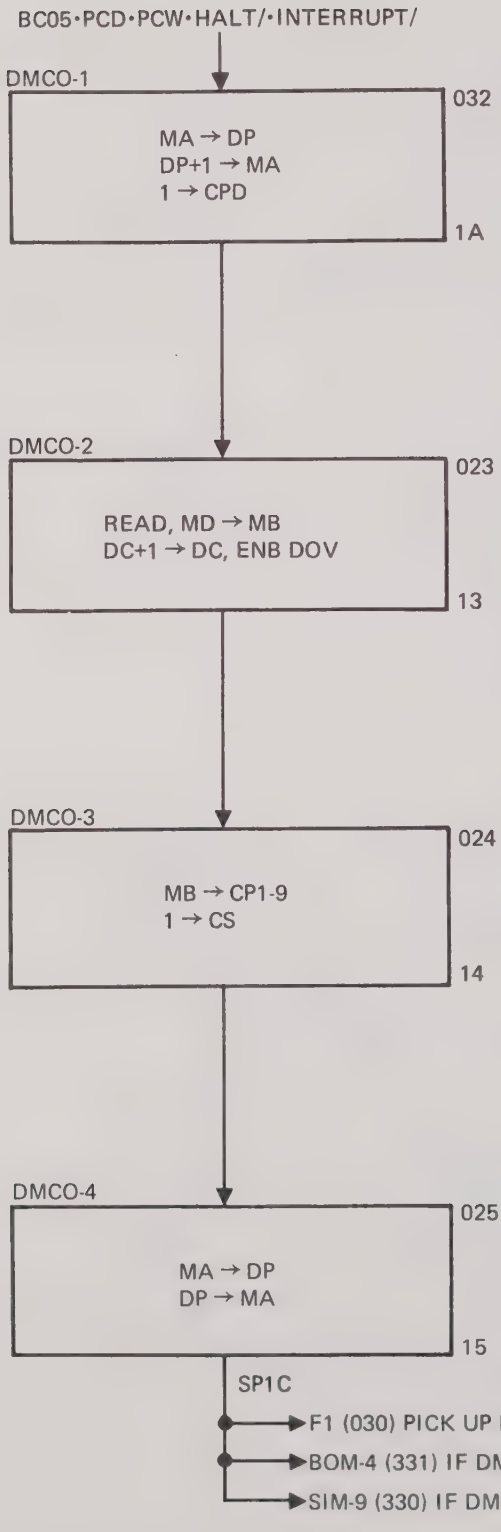
ROM WORD: 0005F074012

ADDEND: 011
AUGEND: 00
ALU: 11111
SUM BUS: 110
DATA SET: 111
A SET: 11
B SET 11

G SET: 0
CI: 00
CO: 00
MEM: 01
SPEC: SP1C
TEST: 0000
NEXT: D9

ROM WORD: 67F7F03C0D9

DMC OUTPUT CYCLE



ADDEND: 011
AUGEND: 00
ALU: 00000
SUM BUS: 110
DATA SET: 111
A SET: 11
B SET: 11

G SET: 0
CI: 01
CO: 00
MEM: 11
SPEC: SP13
TEST: 0000
NEXT: 13

ROM WORD: 6037F273013

ADDEND: 010
AUGEND: 00
ALU: 00000
SUM BUS: 110
DATA SET: 011
A SET: 11
B SET: 11

G SET: 0
CI: 01
CO: 00
MEM: 10
SPEC: SP16
TEST: 0000
NEXT: 14

ROM WORD: 4033F256014

ADDEND: 100
AUGEND: 00
ALU: 11111
SUM BUS: 110
DATA SET: 000
A SET: 11
B SET: 11

G SET: 0
CI: 00
CO: 00
MEM: 11
SPEC: SP14
TEST: 0000
NEXT: 15

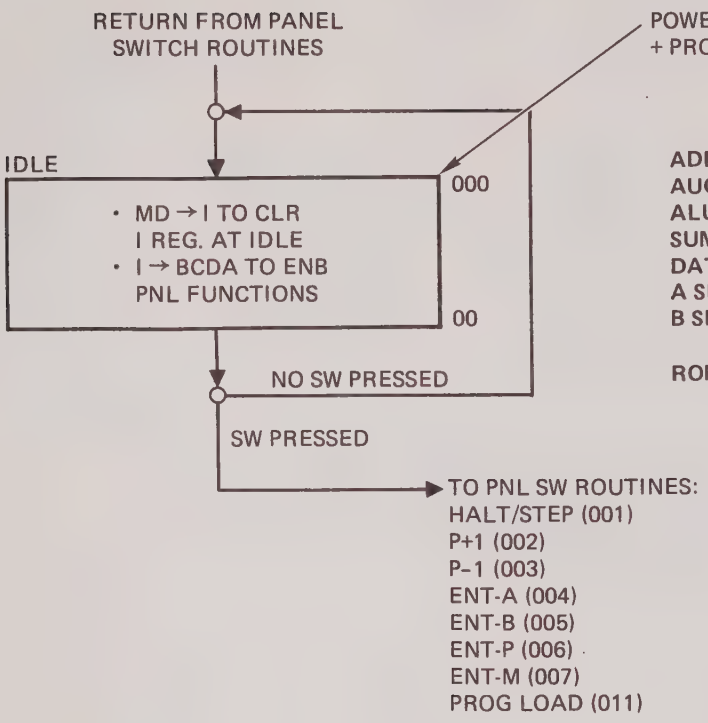
ROM WORD: 87F0F074015

ADDEND: 011
AUGEND: 00
ALU: 11111
SUM BUS: 110
DATA SET: 111
A SET: 11
B SET 11

G SET: 0
CI: 00
CO: 00
MEM: 11
SPEC: SP1C
TEST: 0000
NEXT: D9

ROM WORD: 67F7F07C0D9

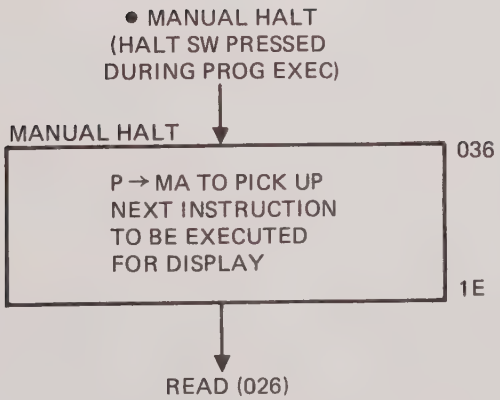
IDLE, PANEL ROUTINES –



ADDEND: 000
AUGEND: 00
ALU: 00000
SUM BUS: 000
DATA SET: 000
A SET: 11
B SET: 11

G SET: 0
CI: 00
CO: 00
MEM: 11
SPEC: SP01
TEST: BCD
NEXT: 0F

ROM WORD: 0000F061D0F

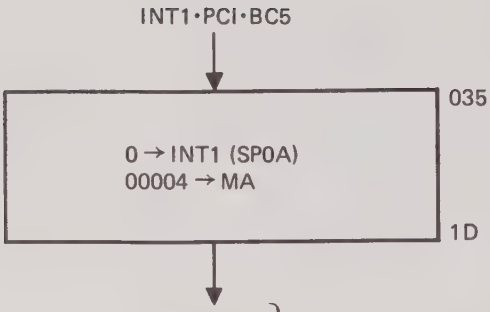


ADDEND: 001
AUGEND: 00
ALU: 11111
SUM BUS: 110
DATA SET: 001
A SET: 11
B SET: 11

G SET: 0
CI: 00
CO: 00
MEM: 11
SPEC: 00000
TEST: 0000
NEXT: 16

ROM WORD: 27F1F060016

INTERRUPT CYCLE, ENTRY TO

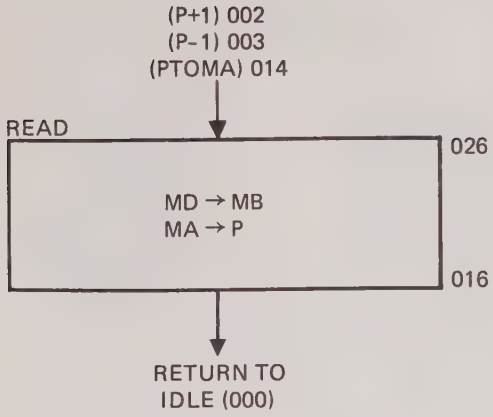


ADDEND: 000
AUGEND: 00
ALU: 10101
SUM BUS: 110
DATA SET: 001
A SET: 11
B SET: 11

G SET: 0
CI: 00
CO: 00
MEM: 11
SPEC: SP0A
TEST: 0000
NEXT: A5

ROM WORD: 0571F06A0A5

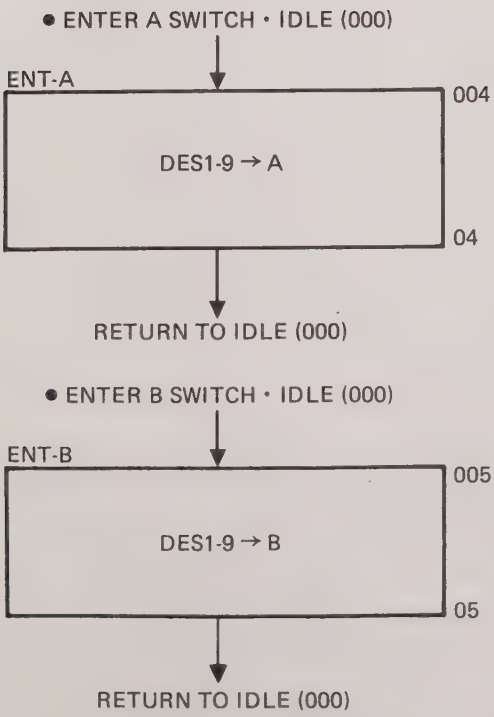
JST INSTRUCTION IS FORCED TO STORE (LOCATIONS 00004 AND 00005) THE PROGRAM COUNT OF THE INSTRUCTION TO BE EXECUTED UPON RETURNING FROM A CPU INTERRUPT SERVICE ROUTINE



ADDEND: 000
AUGEND: 00
ALU: 11111
SUM BUS: 110
DATA SET: 010
A SET: 11
B SET: 11

G SET: 0
CI: 00
CO: 00
MEM: 10
SPEC: 00000
TEST: 0000
NEXT: 00

ROM WORD: 07F2F040000



ADDEND: 000
AUGEND: 00
ALU: 00000
SUM BUS: 000
DATA SET: 000
A SET: 01
B SET: 11

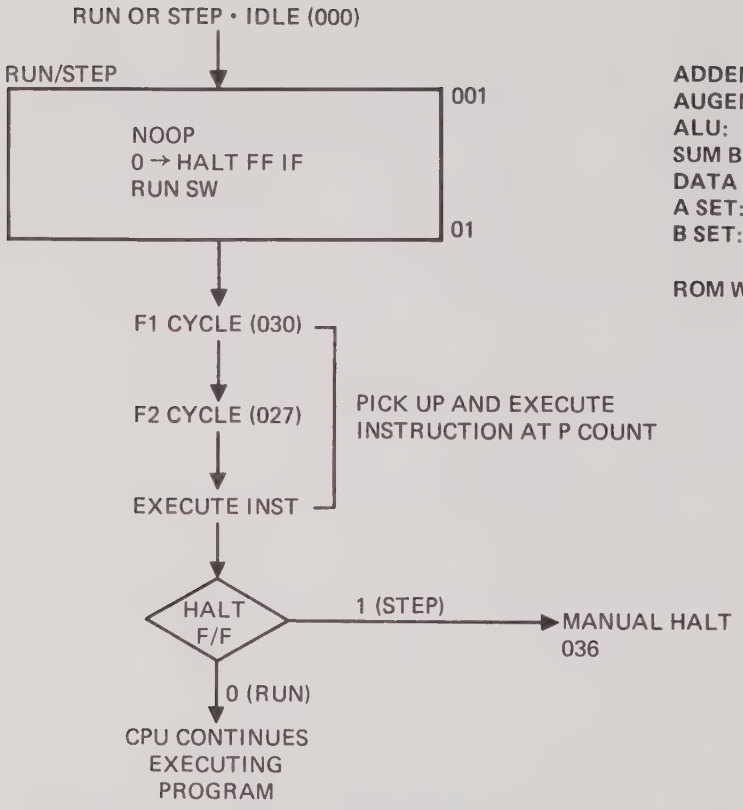
G SET: 0
CI: 00
CO: 00
MEM: 11
SPEC: SP18
TEST: 0000
NEXT: 00

ROM WORD: 00007078000

ADDEND: 0000
AUGEND: 00
ALU: 00000
SUM BUS: 000
DATA SET: 000
A SET: 11
B SET 01

G SET: 0
CI: 00
CO: 00
MEM: 11
SPEC: SP18
TEST: 0000
NEXT: 00

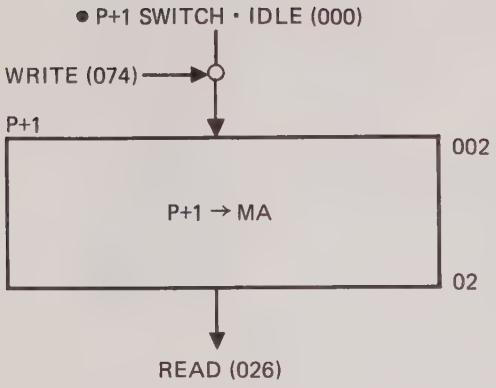
ROM WORD: 0000D078000



ADDEND: 000
AUGEND: 00
ALU: 00000
SUM BUS: 000
DATA SET: 000
A SET: 11
B SET: 11

G SET: 0
CI: 00
CO: 00
MEM: 11
SPEC: 00000
TEST: 0000
NEXT: 18

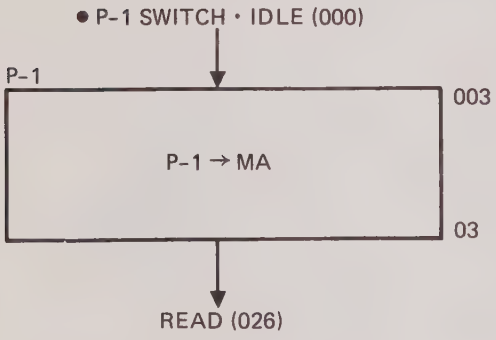
ROM WORD: 0000F060018



ADDEND: 001
AUGEND: 00
ALU: 00000
SUM BUS: 110
DATA SET: 001
A SET: 11
B SET: 11

G SET: 0
CI: 01
CO: 00
MEM: 11
SPEC: 00000
TEST: 0000
NEXT: 16

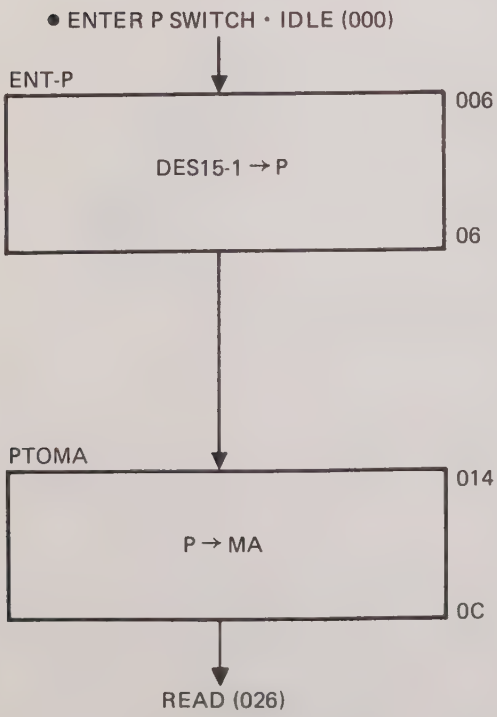
ROM WORD: 2031F260016



ADDEND: 001
AUGEND: 00
ALU: 11110
SUM BUS: 110
DATA SET: 01
A SET: 11
B SET: 11

G SET: 0
CI: 00
CO: 00
MEM: 11
SPEC: 00000
TEST: 0000
NEXT: 16

ROM WORD: 27B1F060016



ADDEND: 000
AUGEND: 00
ALU: 000000
SUM BUS: 000
DATA SET: 010
A SET: 11
B SET: 11

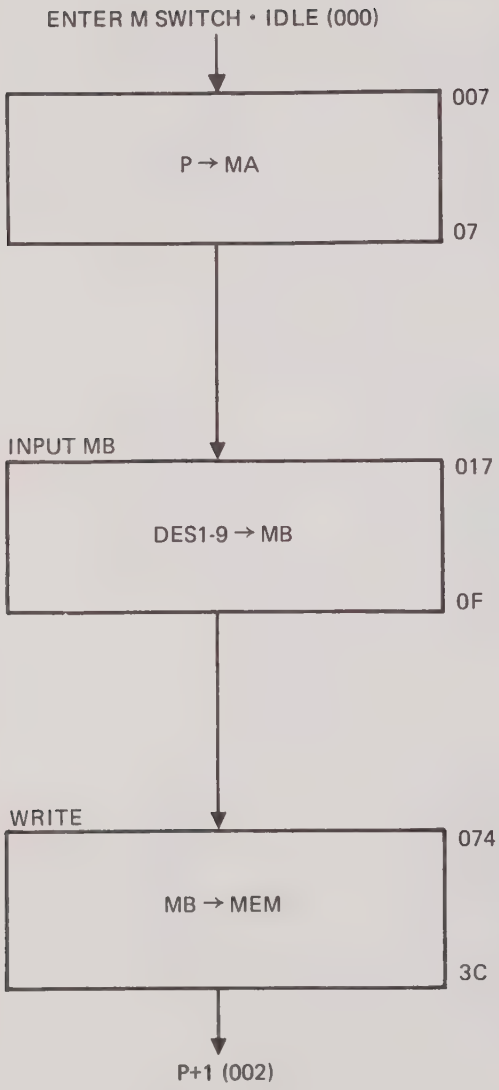
G SET: 0
CI: 00
CO: 00
MEM: 11
SPEC: SP18
TEST: 0000
NEXT: 0C

ROM WORD: 0002F07800C

ADDEND: 001
AUGEND: 00
ALU: 11111
SUM BUS: 110
DATA SET: 001
A SET: 11
B SET 11

G SET: 0
CI: 00
CO: 00
MEM: 11
SPEC: 00000
TEST: 0000
NEXT: 16

ROM WORD: 27F1F060016



ADDEND: 001
AUGEND: 00
ALU: 11111
SUM BUS: 110
DATA SET: 001
A SET: 11
B SET: 11

G SET: 0
CI: 00
CO: 00
MEM: 11
SPEC: 00000
TEST: 0000
NEXT: 0F

ROM WORD: 27F1F06000F

ADDEND: 000
AUGEND: 00
ALU: 00000
SUM BUS: 000
DATA SET: 101
A SET: 11
B SET: 11

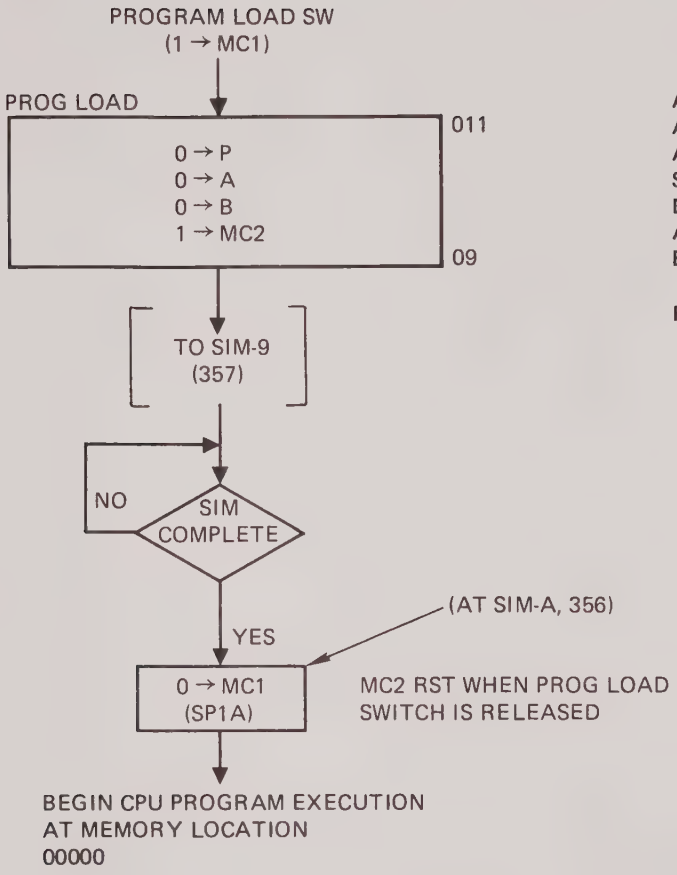
G SET: 0
CI: 00
CO: 00
MEM: 11
SPEC: SP18
TEST: 0000
NEXT: 3C

ROM WORD: 0005F07803C

ADDEND: 000
AUGEND: 00
ALU: 000000
SUM BUS: 000
DATA SET: 000
A SET: 11
B SET: 11

G SET: 0
CI: 00
CO: 00
MEM: 01
SPEC: 00000
TEST: 0000
NEXT: 02

ROM WORD: 0000F020002



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SECTION 9

ILLUSTRATED PARTS BREAKDOWN

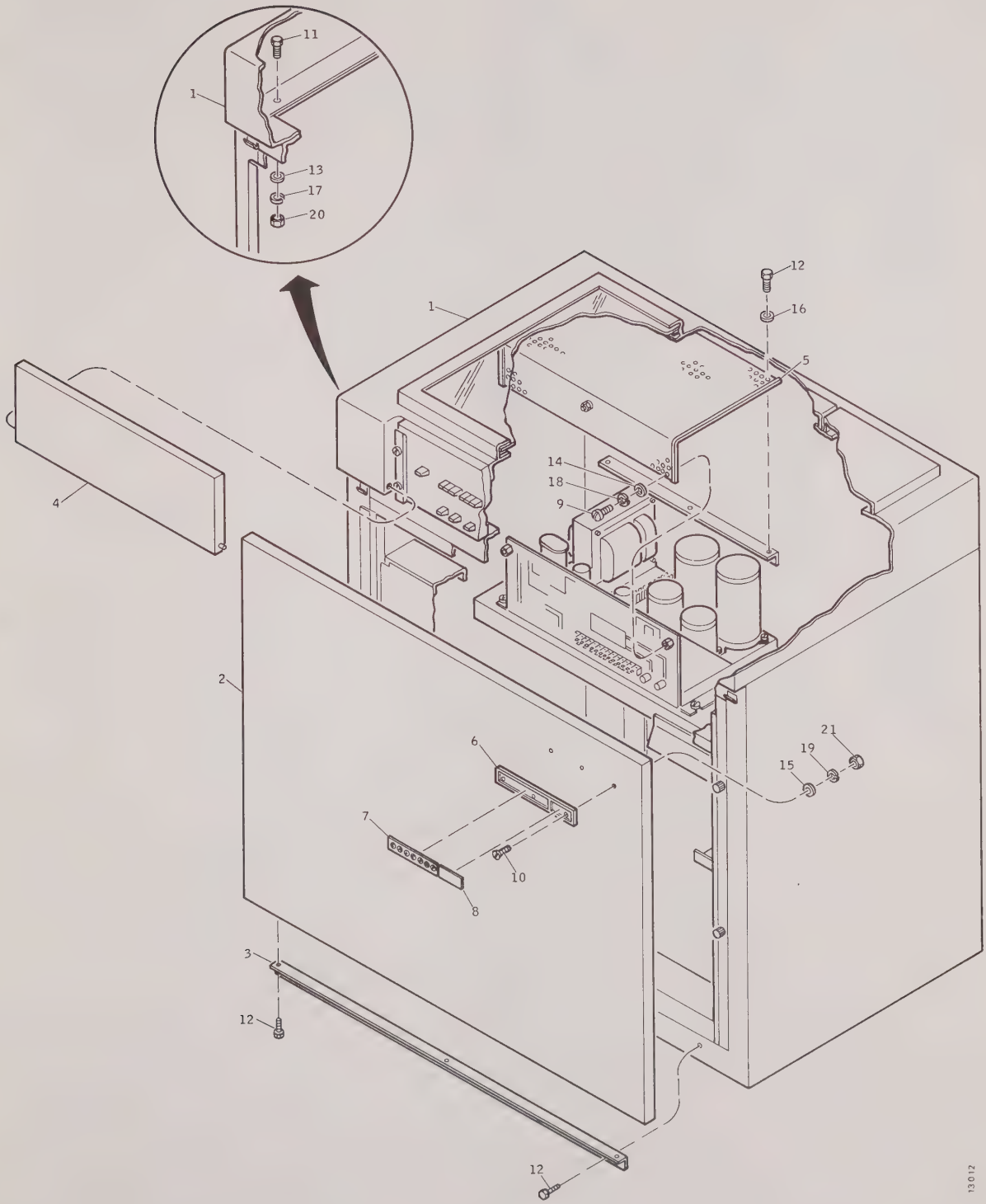

Figure 9-1. Assembly, 921 Controller, 60 Hz

Figure/ Item No.	I.C. Number	Part Number	Description	Rev. Ltr.	Qty Per Assy.
2-	431240-1	10520-310-000	Assembly, Functional Test (see Fig. 6-1 for NHA)	1	1
-1	372550-4	21296-203-000	. Frame - Cabinet		1
-2	372560-3	21319-203-000	. Main Frame		1
-3	372570-2	21314-203-000	. Cover - Operator		1
-4	425610-3	21695-203-000	. Sub Panel		1
-5	388540-7	21298-203-000	. Rod Support		1
-6	372600-7	21320-203-000	. SPT Angle Rear		1
-7	372610-6	21320-203-000	. SPT Angle R.H.		1
-8	372620-5	21322-203-000	. SPT Angle FR		2
-9	372630-4	21323-203-000	. SPT Angle L.H.		1
-10	388530-8	21298-203-000	. Rod - Support		1
-11	325610-8	10313-310-500	. Tape Deck (see Fig. 6-3 for Components)		1
-12	372050-2	21297-203-001	. Bracket Hinge L.H.		1
-13	300790-3	20450-502-000	. Control B		1
-14	372660-1	21297-203-002	. Bracket - Hinge R.H.		1
-15	419860-2	10511-310-011	. Assy, Pwr Adapter (see Fig. 6-4 for Components)		1
-16	413910-1	10505-310-000	. Prog/Maint. Pnl		1
-17	376240-8	74005-206-260	. Washer - Fiber		2
-18	325490-1	20154-402-000	. Ac Power Supply (see Fig. 6-5 for Components)		1
-19	372350-9	20604-502-000	. Assy-Opr Pnl		1
-20	431260-9	10521-310-000	. Cont Gate (see Fig. 6-6 for Components)		1
-21	300740-8	20449-502-000	. Control A, J18		1
-22	251050-1	44014-206-019	. Grommet, Black		31 IN.
-23	325800-1	20451-502-500	. Motion Fwd/Rew, J4		1
-24	298970-5	20444-502-000	. Input/Rewind, J5		1
-25	216150-3	20217-502-000	. Servo Capstan, J16		1
-26	419080-7	20159-502-100	. Char. Status, J3		1
-27	193740-8	20157-502-000	. R. Reg/Int., J2		1
-28	022500-3	52003-206-045	. Roll Pin		2
-29	171900-4	60010-206-250	. Screw Pan Hd, 6-32 x 5/8		4
-30	029730-9	60010-206-291	. Screw Pan Hd, 8-32 x 3/8		10
-31	161290-2	60010-206-359	. Screw Pan Hd, 10-32 x 1/2		8
-32	342820-8	66500-206-019	. Screw Shoulder, 10-32		2
-33	269880-1	60005-206-246	. Screw Flat Hd, 6-32 x 5/16, 100°		4
-34	171740-4	74002-206-112	. Washer - Flat, #6		26
-35	074670-1	74002-206-143	. Washer - Flat, #8 x 0.06 THK		10
-36	157710-5	74002-206-261	. Washer - Flat, 1/4 I.D. x 1/32 THK		6
-37	025630-5	74002-206-192	. Washer - Flat, #10 x 0.06 THK		12
-38	019840-8	74001-206-192	. Washer - Flat, #10 x 7/8 Dia		6
-39	030070-7	74007-206-111	. L'Washer Split, #6		26
-40	030080-6	74007-206-141	. L'Washer Split, #8		10
-41	030090-5	74007-206-191	. L'Washer Split, #10		18
-42	261200-0	50007-206-019	. Nut-Self Locking, 1/4-28		2
-43	171960-8	60010-206-294	. Screw, Pan Hd, 10-32 x 5/8		3
-44	050590-9	50001-206-012	. Nut Hex, #6-32		16
-45	150730-0	74002-206-262	. Washer, Flat, 1/4 x 0.06 THK		6
-46	171000-3	50001-206-017	. Nut Hex, #10-32		18
-47	376230-9	74045-206-264	. Washer - Spring		2
-48	361750-3	60070-206-247	. Screw Hex Hd, 6-32 x 3/8, Self Tapping		8
-49	171180-3	32003-206-007	. Bolt-Machine, 1/4-28 x 29/32		2
-50	372760-9	21313-203-000	. Frame		1
-51	372750-0	13351-204-000	. Window		1

Figure/ Item No.	I.C. Number	Part Number	Description	Rev. Ltr.	Qty Per Assy.
2-52	372740-1	21311-203-000	. Channel Front		1
53	372730-2	21312-203-000	. Channel - Rear		1
-54	372850-8	13422-204-001	. Support L.H.		1
-55	372860-7	13422-204-002	. Support R.H.		1
-56	372680-9	21309-203-001	. Bracket Hinge L.H.		1
-57	372690-8	21309-203-002	. Bracket Hinge R.H.		1
-58	372700-5	21308-203-001	. Support Hinge L.H.		1
-59	372710-4	21308-203-002	. Support Hinge R.H.		1
-60	372720-3	13352-204-000	. Spring Hinge		2
-61	386140-8	13703-204-000	. Hanger - Cover		2
-62	361710-7	60070-206-249	. Screw, Hex Hd, 6-32 x 1/2, Self Tapping		11
-63	346620-8	20430-401-000	. DC Wire Harness		1
	372670-0	13320-204-000	. Overlap Opr Pnl		1
-64	372490-9	20371-401-000	. Cable		1
-65	413930-9	20551-401-000	. Cable - Jumper		1
-66	413940-8	20547-401-000	. DC Harness		1
-67	346800-6	20401-401-004	. Cable Assy - AC		1
-68	431250-0	20574-401-000	. Cable - Jumper		1
-69	419090-6	20555-401-000	. Adapter Cable		1
	372890-4	10004-209-002	. Foam Tape, 1/16 x 3/4		112"
	251320-8	10032-206-001	. Push Mount		7
	260940-2	10029-206-004	. Clamp Cable, V2		9
	269190-5	10033-206-002	. Ty Wrap		7
	223000-1	10003-206-003	. Cable - Clamp, 1/8 I.D.		3
	346190-3	10009-209-005	. Tape - Hook		16 IN.
	346200-0	10010-209-006	. Tape - Loop		16 IN.
-70	376430-5	20491-401-000	. Cable		1

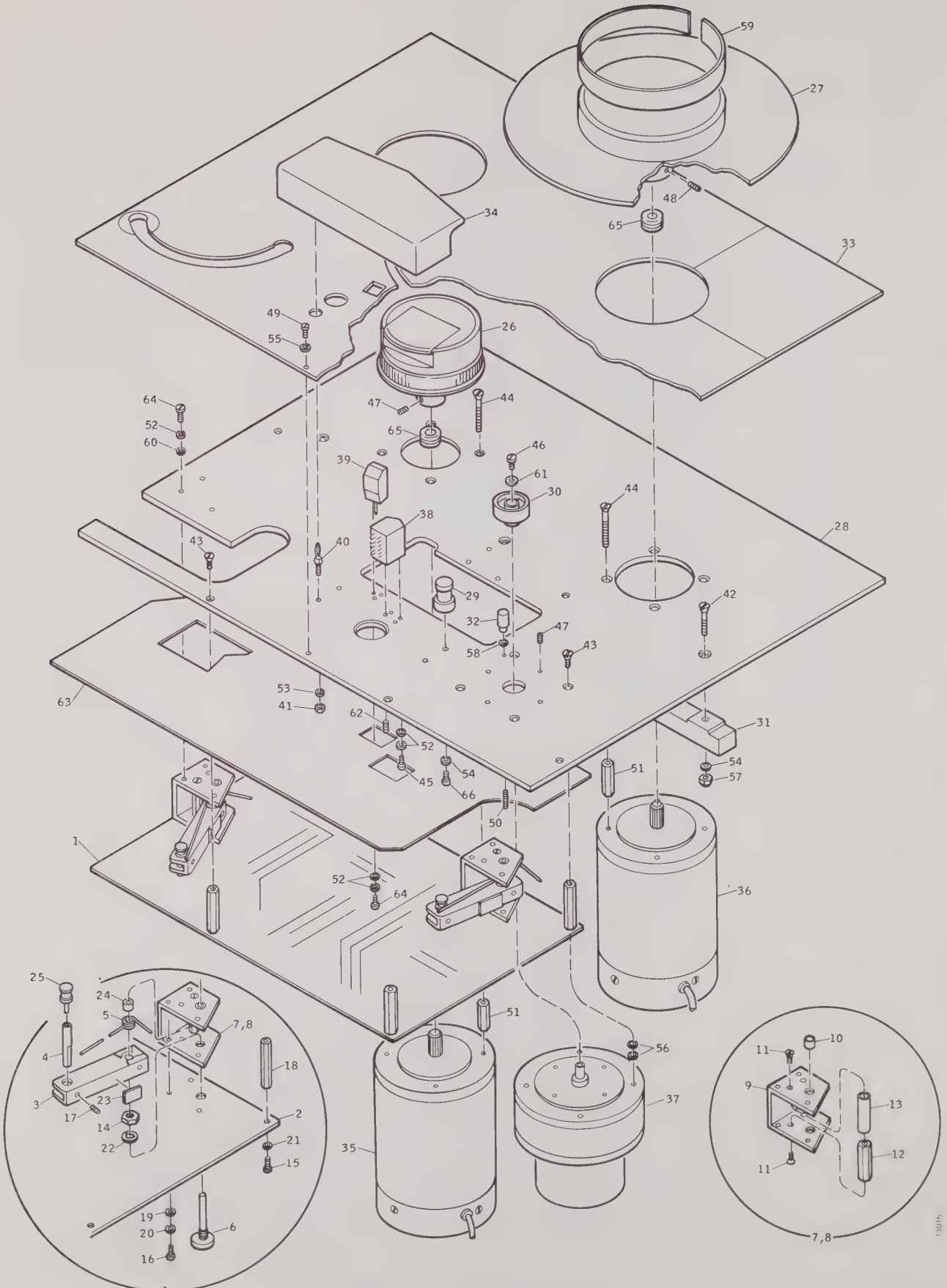

Figure 9-3. Assembly, Tape Deck

Figure/ Item No.	I.C. Number	Part Number	Description	Rev. Ltr.	Qty Per Assy.
3-	325670-8	10313-310-500	Assembly, Tape Deck (see Fig. 6-2 for NHA)	13	1
-1	321490-5	10344-310-000	. Servo Pwr Assy		1
-2	399800-2	20711-502-000	. . PCB Assy		1
-3	304320-5	12065-204-000	. . Arm		2
-4	417690-5	12432-204-100	. . Adaptor		2
-5	320650-5	12433-204-000	. . Spring - Torsion		2
-6	323700-5	30501-504-450	. . Potentiometer		2
-7	335610-2	12631-204-011	. . Bracket		1
-8	335760-5	12631-201-012	. . Bracket		1
-9	317760-7	12412-204-000	. . . Bracket - Pot.		1
-10	091550-4	20007-207-001	. . . Bearing - Sleeve, 0.2502 I.D.		1
-11	167730-1	60005-206-166	. . . Screw - Flat Hd., 4-40 x 0.31 LG		2
-12	333650-0	72032-206-020	. . . Spacer, 4-40 x 1.50 LG		1
-13	364670-0	55010-206-014	. . . Tubing, Tygon		1.5 IN
-14	157640-4	50005-206-047	. . Nut - Hex, Thin, 3/8-32		2
-15	029730-9	60010-206-291	. . Screw - Pan Hd., 8-32 x 0.38 LG		4
-16	029500-6	60010-206-165	. . Screw - Pan Hd., 4-40 x 0.25 LG		6
-17	174860-7	60043-206-167	. . Screw - Socket Hd., 4-40 x 0.38 LG		4
-18	329180-4	72026-206-044	. . Standoff, 3-32 x 1.75 LG		4
-19	029300-1	74002-206-073	. . Washer - Flat, #4		6
-20	150700-3	74008-206-071	. . L'Washer, #4		6
-21	151790-3	74005-206-141	. . L'Washer, #8		4
-22	172170-3	74008-206-351	. . L'Washer, 3/8		2
-23	417180-7	10344-310-003	. . Pad, 2		2
-24	333630-2	12623-204-000	. . Spacer - Spring		2
-25	321570-4	20503-202-001	. . Spool		2
-26	325710-2	11475-211-500	. Reel Holder		1
-27	335730-0	11478-211-500	. Reel Assy		1
-28	304280-1	12064-204-000	. Baseplate		1
-29	304490-6	12074-204-000	. Guide - Fixed		2
-30	322260-1	12461-204-000	. Capstan		1
-31	335580-7	12630-204-000	. Stiffener		1
-32	374930-6	20505-207-001	. Rotary Guide		1
-33	304440-1	20836-203-000	. Panel		1
-34	318940-4	20950-203-000	. Cover - Read Hd.		1
-35	325680-7	10153-301-511	. Motor (File)		1
-36	325690-6	10153-301-521	. Motor (Take - Up)		1
-37	326700-3	10154-301-500	. Motor - Capstan		1
-38	322140-5	20012-302-000	. Read Head		1
-39	321970-6	10345-310-000	. Bot Sensor		1
-40	322160-3	13514-206-000	. Banana Plug, 6-32		2
-41	050570-9	50001-206-012	. Nut - Hex, 6-32		2
-42	336080-7	60005-206-364	. Screw - Flat Hd., 10-32 x 1.25 LG		3
-43	270940-0	60005-206-293	. Screw - Flat Hd., 8-32 x 0.50 LG		8
-44	331000-0	60005-206-366	. Screw - Flat Hd., 10-32 x 150 LG		8
-45	029520-4	60010-206-167	. Screw - Pan Hd., 4-40 x 0.38 LG		2
-46	343510-4	60041-206-360	. Screw - Pan Hd., 10-32 x 0.62 LG, Black		1
-47	164610-8	60037-206-355	. Screw - Set, 10-32 x 0.25 LG		5
-48	230060-6	60037-206-357	. Screw - Set, 10-32 x 0.38 LG		1
-49	247370-0	60041-206-165	. Screw - Pan Hd., 4-40 x 0.25 LG, Black		2
-50	333720-1	60027-206-250	. Screw - Set, 6-32 x 0.62 LG		1
-51	330990-3	72028-206-002	. Standoff, #10 x 1.00 LG		8
-52	150700-3	74008-206-071	. L'Washer, #4		10

Figure/ Item No.	I.C. Number	Part Number	Description	Rev. Ltr.	Qty Per Assy.
3-53	030010-3	74008-206-111	. L'Washer, #6		2
-54	171670-3	74008-206-191	. L'Washer, #10		5
-55	210610-2	74024-206-071	. L'Washer, #4, Black		2
-56	330030-8	74033-206-012	. Washer - Flat, #8		8
-57	171000-3	50001-206-017	. Nut - Hex, 10-32		3
-58	171740-4	74002-206-112	. Washer - Flat, #6		2
-59	374850-6	10035-209-001	. Tape		16.5"
-60	019890-3	74002-206-036	. Washer - Flat, #4		6
-61	314800-4	74028-206-191	. Washer - Flat, Black Oxide		1
-62	174970-4	60037-206-245	. Screw - Set, 6-32 x 1/4		2
-63	441480-1	13233-204-100	. Cover - PCB		1
-64	029530-3	60010-206-168	. Screw - Pan Hd., 4-40 x 0.44 LG		8
-65	016350-1	44003-206-004	. Grommet		2
-66	050480-3	60010-206-360	. Screw - Pan Hd., 10-32 x 0.62 LG, Black		2
	187230-8	11143-204-000	. Nameplate		1

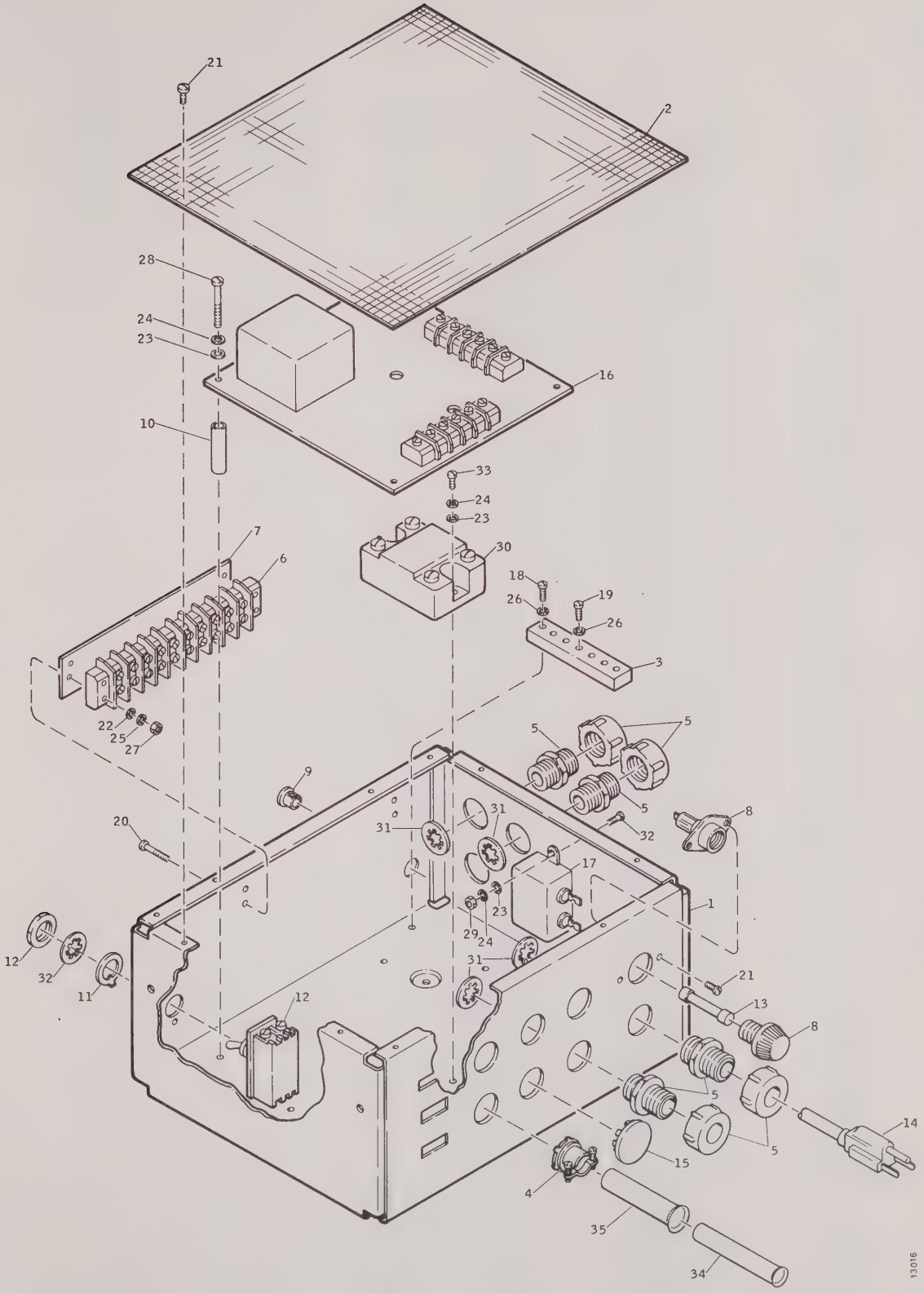

Figure 9-4. Assembly, AI Power Adapter

Figure/ Item No.	I.C. Number	Part Number	Description	Rev. Ltr.	Qty Per Assy.
4-	419860-2	10511-310-011	Assembly, Ac Power Adapter (see Fig. 6-2 for NHA)		1
-1	419850-3	21594-203-000	. Chassis		1
-2	419840-4	21595-203-000	. Cover		1
-3	288680-2	11867-204-000	. Bus Bar		1
-4	073990-4	10020-206-001	. Clamp		1
-5	404170-3	10049-206-002	. Cord Grip		4
-6	121050-9	13007-206-010	. Barrier Strip		1
-7	249460-7	13048-206-010	. Marker Strip		1
-8	358300-2	43006-206-002	. Fuse Holder		1
-9	248000-2	36004-206-006	. Snap Bushing		1
-10	419880-0	72010-206-024	. Spacer		4
-11	014880-9	11601-304-000	. Washer		1
-12	408820-9	10131-304-001	. Switch		1
-13	358320-0	40107-304-008	. Fuse, FNM 8A		1
-14	252540-0	20141-401-015	. Cord		1
-15	359610-3	53002-206-007	. Plug		5
-16	421070-4	20780-502-011	. Pwr Adapter		1
-17	401550-9	10126-509-010	. Line Filter		1
-18	029630-1	60010-206-248	. Screw, Pan Hd, 6-32 x 7/16		2
-19	171890-7	60010-206-245	. Screw, Pan Hd, 6-32 x 5/16		5
-20	029550-1	60010-206-170	. Screw, Pan Hd, 4-40 x 5/8		4
-21	361750-3	60070-206-247	. Screw - Self Tap, 6-32 x 3/8		10
-22	029300-1	74002-206-073	. Washer, Flat, #4		4
-23	163750-3	74002-206-111	. Washer, Flat, #6		8
-24	030070-7	74007-206-111	. L'Washer Split, #6		8
-25	030060-8	74007-206-071	. L'Washer Split, #4		4
-26	030010-3	74008-206-111	. L'Washer Int. Th, #6		7
-27	161650-7	50001-206-008	. Nut - Hex, 4-40		4
-28	171920-2	60010-206-254	. Screw, Pan Hd, 6-32 x 1-1/4		4
-29	173620-6	50003-206-012	. Nut - Hex, 6-32		2
-30	400980-9	21503-304-003	. Relay, 240 Vac, 25A		1
-31	404160-4	50068-206-002	. Locknut		4
-32	145710-0	74021-206-009	. L'Washer Int Tooth, #6		1
-33	029620-2	60010-206-247	. Screw, Pan Head, 6-32 x 3/8		4
-34	072710-7	80006-404-006	. Bushing		1
-35	014290-1	80006-404-008	. Bushing		1
	013740-6	11002-206-001	. Jumper		9
	249130-6	11505-206-007	. Lug - Ring		12
	174100-8	11507-206-008	. Lug - Ring		1
	368940-3	11507-206-014	. Lug - Ring		1
	031440-1	11535-206-001	. Lug - Solderless		4
	205920-2	80305-404-002	. Contact Female		2
	205940-0	80306-404-002	. Contact Male		2
	274550-3	80309-404-001	. Housing		1
	396530-8	11551-206-000	. Lug		1
	401160-7	10204-405-023	. Wire - P.V.C., 16 Awg, Brn		2.5 FT
	391350-6	10204-405-082	. Wire - P.V.C., 18 Awg, Grn/Yel		7 FT
	228170-7	10204-405-098	. Wire - P.V.C., 16 Awg, Lt. Blu		2 FT
	405820-2	10207-405-140	. Wire - P.V.C., 22 Awg, Wht		1 FT
	252550-9	40108-405-002	. Cable		4.5 FT

Figure/ Item No.	I.C. Number	Part Number	Description	Rev. Ltr.	Qty Per Assy.
4-	175040-5	11254-204-000	. I.D. Plate		2
	006680-3	10033-204-000	. Nameplate		1
	072380-9	11119-204-000	. Plate - Data		1
	402040-0	10026-213-000	. Decal		1
	262270-2	10006-213-000	. Decal - Warning		1

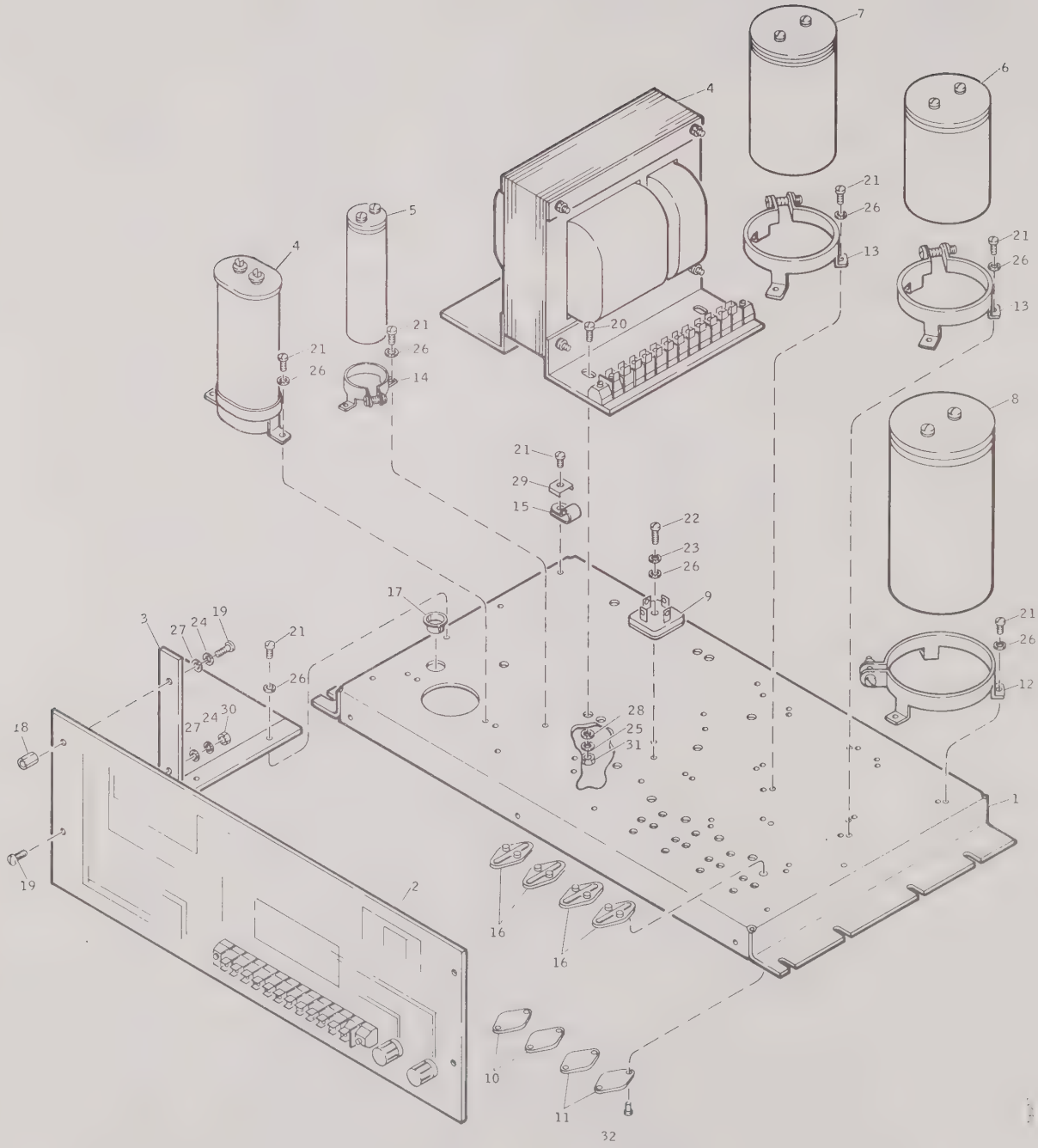

Figure 9-5. Assembly, Power Supply

Figure/ Item No.	I.C. Number	Part Number	Description	Rev. Ltr.	Qty Per Assy.
5-	325490-1	20154-402-000	Assembly, Power Supply (see Fig. 6-2 for NHA)	9	1
-1	329140-8	21003-203-000	. Chassis		1
-2	329540-9	20508-502-000	. Assy		1
-3	329960-9	21011-203-001	. Bracket		2
-4	321890-6	10142-403-000	. Transformer		1
-5	097300-8	10105-505-445	. Capacitor, 8 ,700 μf, 25V		2
-6	186500-5	10105-505-474	. Capacitor, 32,000 μf, 25V		1
-7	329780-1	10103-505-484	. Capacitor, 51,000 μf, 15V		1
-8	204640-7	10106-505-489	. Capacitor, 64,000 μf, 30V		2
-9	340530-5	70206-506-334	. Diode Bridge, MDA 990-1		4
-10	329810-6	50301-507-000	. Transistor, 2N3771, Q3, Q4		1 pr.
-11	061920-5	20403-507-000	. Transistor, 2N3055, Q1, Q2		2
-12	244700-1	10027-206-001	. Clamp - Capacitor		2
-13	189580-4	10025-206-003	. Clamp - Capacitor		2
-14	033420-1	10021-206-002	. Clamp - Capacitor		2
-15	022400-6	10006-206-005	. Clamp - Cable		1
-16	190160-2	12015-206-001	. Socket - TSTR		4
-17	287870-0	36004-206-013	. Snap Bushing		1
-18	346700-8	72006-206-004	. Spacer		2
-19	172030-9	60010-206-357	. Screw Pan Hd, 10-32 x 3/8		6
-20	171150-6	32003-206-004	. Bolt - Hex, 1/4 - 28 x 1/2		4
-21	326680-6	60067-206-249	. Screw Pan Hd, 6-32 x 1/2, Self Tapping		25
-22	359710-1	60067-206-251	. Screw Pan Hd, 6-32 x 3/4, Self Tapping		4
-23	030070-7	74007-206-111	. L'Washer Split, #6		4
-24	030090-5	74007-206-191	. L'Washer Split, #10		6
-25	172240-4	74007-206-261	. L'Washer Split, #1/4		4
-26	163750-3	74002-206-111	. Washer Flat, #6		29
-27	171710-7	74002-206-191	. Washer Flat, #10		6
-28	157710-5	74002-206-261	. Washer Flat, #14		4
-29	026600-7	74018-206-002	. D'Washer		1
-30	171000-3	50001-206-017	. Nut - Hex, 10-32		2
-31	171040-9	50001-206-019	. Nut - Hex, 1/4-28		4
-32	069530-4	11522-206-001	. Terminal		8
	336170-6	10810-406-000	. Wire List, Cont #710		1
	187230-8	11143-204-000	. Nameplate		1
	031440-1	11535-206-001	. Terminal Faston, Female		40
	157700-6	11507-206-011	. Lug - Terminal, #10		4
	013880-0	11505-206-009	. Terminal - Solderless, Ring Tongue		24
	359330-8	13232-204-000	. Label		1
	226130-3	11530-206-001	. Terminal		2

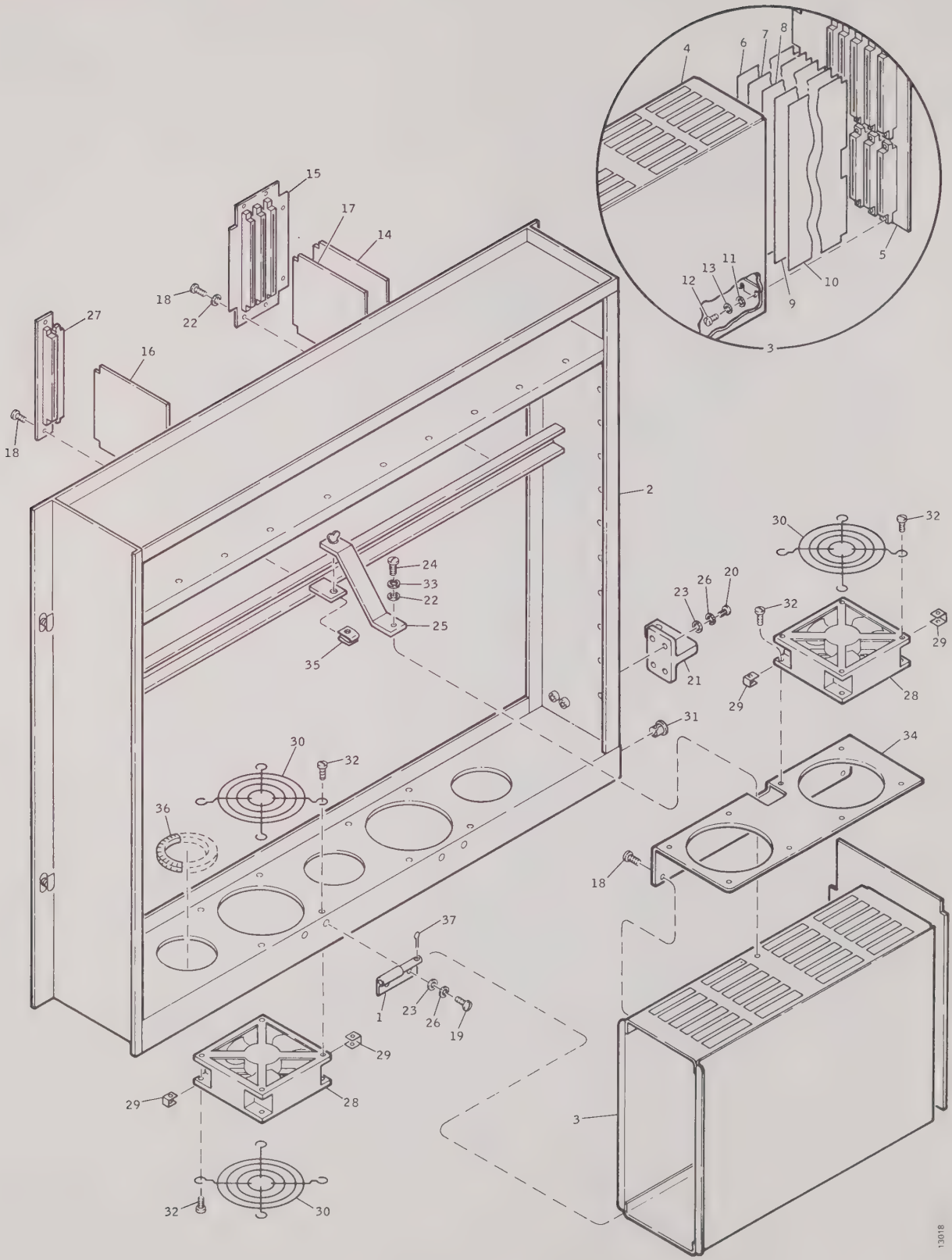

Figure 9-6. Assembly, Controller Gate

Figure/ Item No.	I.C. Number	Part Number	Description	Rev. Ltr.	Qty. Per Assy.
6-	431260-9	10521-310-000	Gate Assy - 921 Controller (see Fig. 6-2 for NHA)	1	1
-1	362520-9	20407-203-007	. Half-Hinge, Male		2
-2	316440-7	20439-203-000	. Frame		1
-3	413960-6	10506-310-000	. CPU Memory Assy		1
-4	319300-0	20951-203-000	. . Chassis		1
-5	414000-0	20778-502-000	. . MIB Board		1
-6	425490-0	20771-502-100	. . CPU Bd. #1		1
-7	414020-8	20772-502-000	. . CPU Bd. #2		1
-8	414030-7	20773-502-000	. . CPU Bd. #3		1
-9	414040-6	20774-502-000	. . CPU Bd. #4		1
-10	414900-1	20779-502-100	. . Memory - Bk		1
-11	151840-6	74002-206-072	. . Washer - Flat #4		30
-12	029530-3	60010-206-168	. . Screw, Pan Hd, 4-40 x 7/16		20
-13	030060-8	74007-206-071	. . L'Washer, Split #4		20
-14	443720-8	20871-502-000	. Prog Loader Mod		1
-15	425550-1	20543-502-002	. Father Board		1
-16	338460-9	20526-502-000	. Assy - I/O Simulator		1
-17	413990-3	20777-502-000	. Cable - CPU I/O		1
-18	361750-3	60070-206-247	. Screw, Self-Tap, 6-32 x 3/8		10
-19	172110-9	60010-206-447	. Screw, Pan Hd, 1/4-28 x 1/2		4
-20	171180-3	32003-206-007	. Bolt - Hex, 1/4-28 x 29/32		8
-21	239450-0	11332-204-007	. Bracket - Hinge		2
-22	171740-4	74002-206-112	. Flat Washer, #6		1
-23	150730-0	74002-206-262	. Flat Washer, #1/4		24
-24	029620-2	60010-206-247	. Screw, 6-32 x 3/8		1
-25	323840-9	20973-203-000	. Bracket		1
-26	172240-4	74007-206-261	. L'Washer, Split #1/4		12
-27	206710-6	20195-502-000	. Assy - Terminator, Motherboard		1
-28	022240-6	10031-301-000	. Fan		4
-29	336060-9	41057-206-001	. Clip		32
-30	289290-9	50015-301-000	. Finger Guard		6
-31	350180-6	36004-206-008	. Bushing		1
-32	171900-4	60010-206-250	. Screw - Pan Hd, 6-32 x 5/8		32
-33	030070-7	74007-206-111	. L'Washer, Split #6		1
-34	415830-9	21587-203-000	. Bracket		1
-35	339960-7	41060-206-001	. Clip - Mtg.		1
-36	423400-1	44014-206-016	. Grommet		5.2'
-37	362490-5	52004-206-200	. Cotter Pin		2
	175040-5	11254-204-000	. . I.D. Plate		1
	006680-3	10033-204-000	. Nameplate		1
	225250-0	50003-301-003	. Power Cord		3
	223410-2	50003-301-006	. Power Cord		1
	359490-0	90107-404-000	. Conn. - Tap		6
	257190-9	10029-206-001	. Clip - Cable		3
	391350-6	10204-405-082	. Wire, P.V.C., 18 AWG, Grn/Yel.		3.5'
	174100-8	11507-206-008	. Lug, Solderless		2
	069860-5	11505-206-008	. Lug, Solderless		3

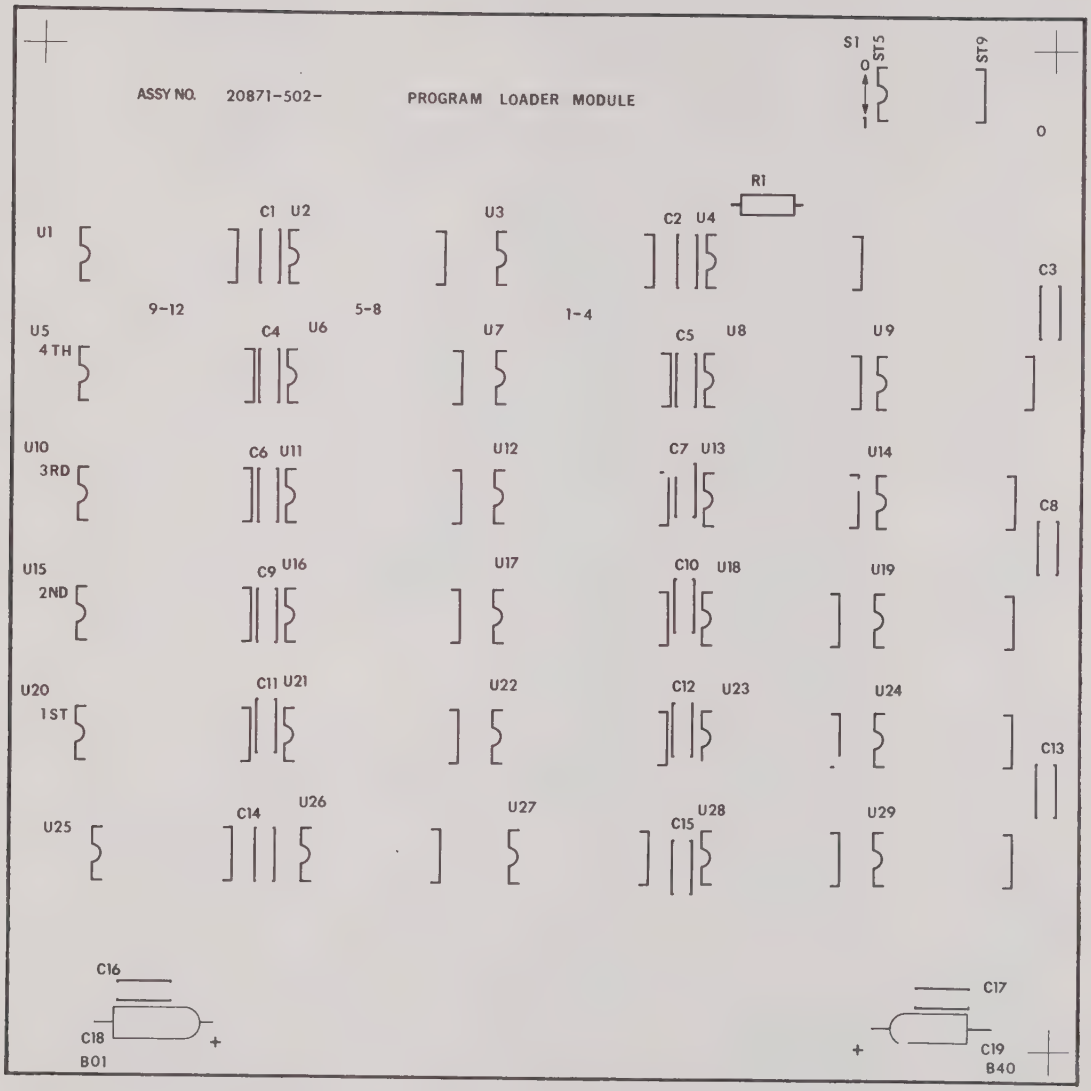

Figure 9-7. Assembly, CF Program Loader Module

Figure/ Item No.	I.C. Number	Part Number	Description	Rev. Ltr.	Qty Per Assy.
7-	443720-8	20871-502-000	Assy CF Program Loader Module (see Figure 6-6 for NHA)	1	1
	235560-0	10214-504-400	. Resistor, 1K Ohm, 2%, 1/4W, Met Film, R1		1
	368450-3	60101-504-432	. Resistor - Net, 4.7K Ohm, 2%, U14		1
	127740-9	10202-505-328	. Capacitor, 39 μf, 10%, 10V, Tant., C18, 19		2
	359530-3	10507-505-150	. Capacitor, 0.01 μf, 25V, 01 thru 17		17
	433540-2	10018-304-005	. Switch - Net, 5 Position (Bit Switch), S1		1
	331920-9	10411-508-000	. Integrated Ckt, SN74161, U1, 2, 3		3
	411620-8	10503-508-000	. Integrated Ckt, SN74LS109, U4		1
	286210-0	10370-508-000	. Integrated Ckt, SN7404, U18		1
	411510-1	10491-508-000	. Integrated Ckt, SN74LS04, U19		1
	416290-5	10528-508-000	. Integrated Ckt, SN74LS20, U23		1
	411540-8	10494-508-000	. Integrated Ckt, SN74LS10, U24		1
	379400-5	10448-508-000	. Integrated Ckt, SN7438, U25, 26, 27, 28, 29		5
	427300-9	50030-404-001	. Socket, 18 Pin Scanbe, U5, 6, 7, 10. 11. 12, 15, 16, 17, 20, 21, 22		12
	431680-8	70004-508-001	. Integrated Ckt, 82S137 Signetics, U5, 6, 7, 10, 11, 12, 15, 16, 17, 20, 21, 22		12
	435370-2	20871-512-000	. Printed Board, Ref. 0.06 x 6.36 x 6.06		1

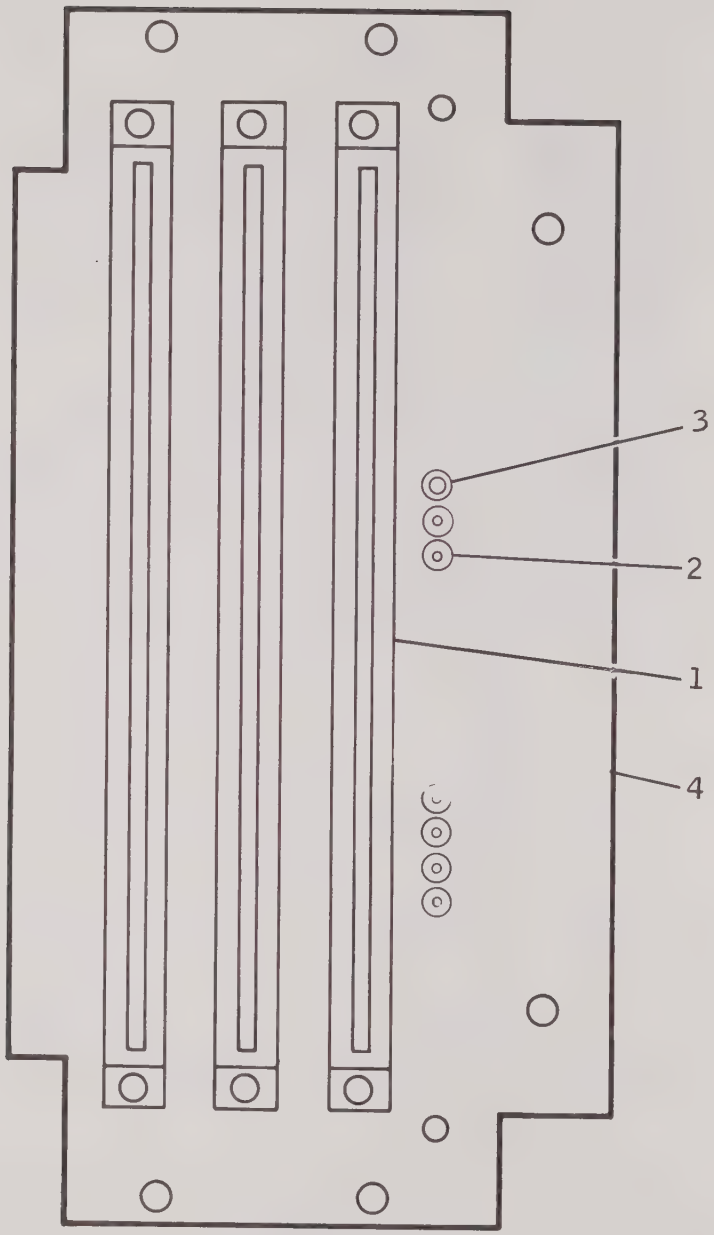

Figure 9-8. Assembly, Fatherboard (Type 3)

Figure/ Item No.	I.C. Number	Part Number	Description	Rev. Ltr.	Qty Per Assy.
8-	425550-1	20543-502-002	Assy - Fatherboard (Type 3) (see Figure 6-6 for NHA)		1
-1	170740-5	30018-404-001	. Connector		2
-2	218420-8	80349-404-001	. Connector, Male		6
-3	218410-9	80350-404-001	. Connector, Female		1
-4	346180-3	20543-512-000	. Printed Board		1
	447190-0	10338-406-100	. Wire List, Control #832		1

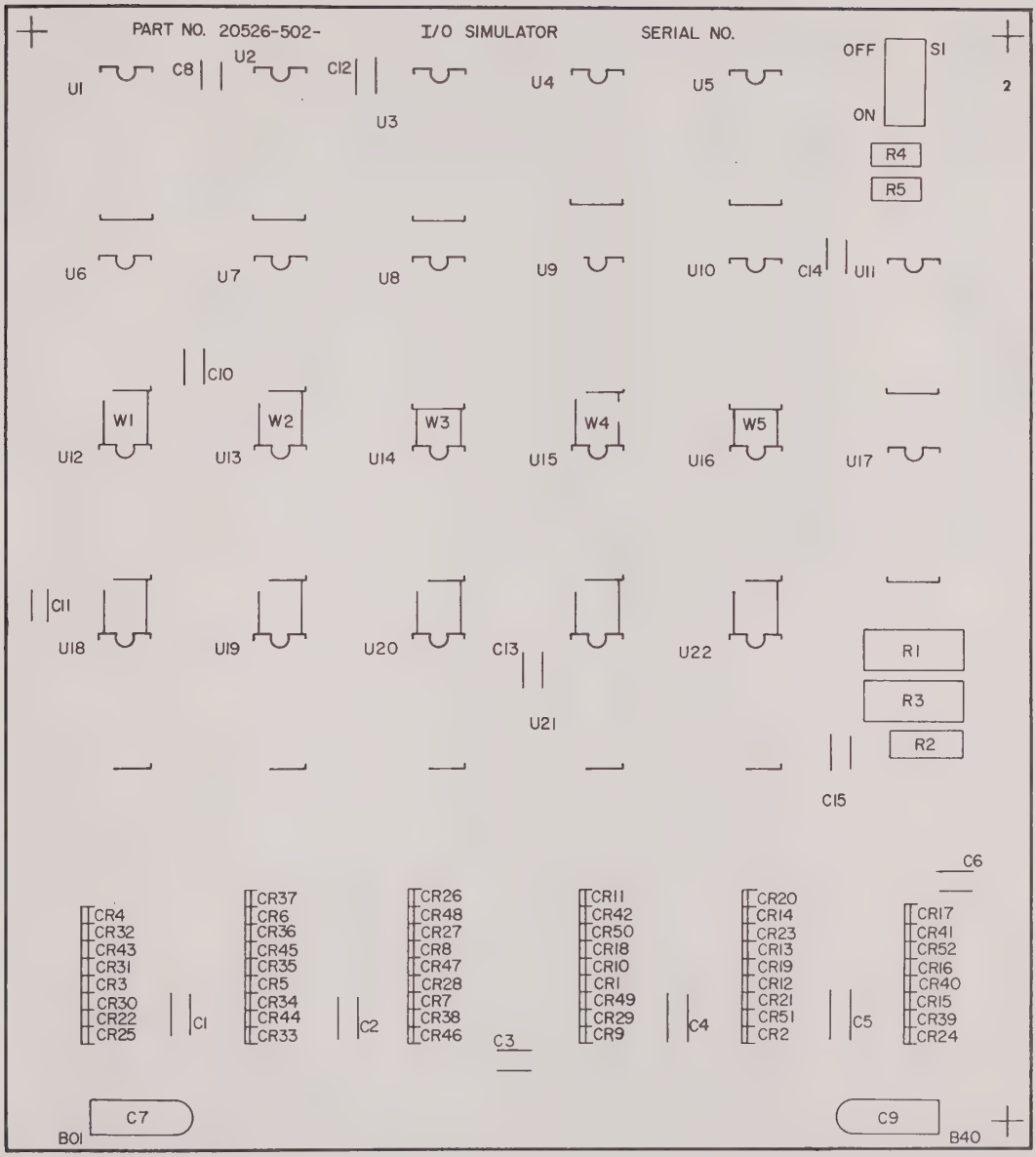

Figure 9-9. Assembly, I/O Simulator

Figure/ Item No.	I.C. Number	Part Number	Description	Ref. Ltr.	Qty. Per Assy.
9-	338460-9	20526-502-000	Assy - I/O Simulator (see Figure 6-6 for NHA)	1	1
	301030-3	20107-405-001	. Bus Bar, W1 thru W5		5
	109180-0	10212-504-432	. Resistor, 4.7K Ohm, ±5%, 1/4W, R4, R5		2
	243690-5	10222-504-282	. Resistor, 4.7 Ohm, ±5%, 1/4W, R2		1
	213050-8	10501-504-314	. Resistor, 20 Ohm, ±5%, 2W, R1, R3		2
	127740-9	10303-505-328	. Capacitor, 39 μf, ±10%, 10V, C7, C9		2
	303450-1	10507-505-190	. Capacitor, 0.068 μf, +50%, -20%, 25V, C1 thru C6, C8, C10 thru C15		13
	033690-9	10201-506-000	. Diode, CR1 thru CR52		52
	274350-8	10356-508-000	. Integrated Ckt, JK Flip-Flop, U8, 10		2
	286170-6	10366-508-000	. Integrated Ckt, 2 Input Nand, U11, 15, 17, 18		4
	286200-1	10369-508-000	. Integrated Ckt, 2 Input Nand, U6, 7, 12, 13, 14		5
	286220-9	10371-508-000	. Integrated Ckt, Hex Inverter, U4, 19, 22		3
	286240-7	10373-508-000	. Integrated Ckt, 3 Input Nand, U2		1
	286260-5	10375-508-000	. Integrated Ckt, 4 Input Nand, U20		1
	286270-4	10376-508-000	. Integrated Ckt, 4 Input And, U5		1
	286420-5	10390-508-000	. Integrated Ckt, Shift Rgtr, U1, 2, 3		3
	286370-2	10391-508-000	. Integrated Ckt, 3 Input And, U9, 16		2
	338470-8	10526-512-000	. Printed Board		1
	268750-7	10120-304-001	. Switch, S1		1

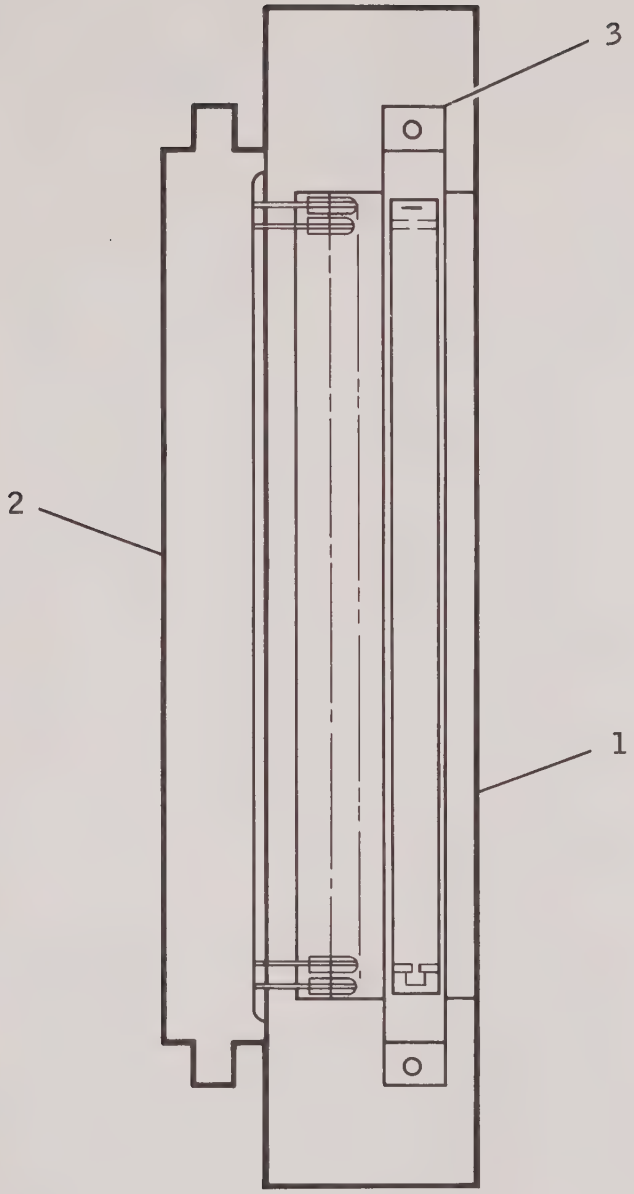

Figure 9-10. Assembly, Terminator Motherboard

Figure/ Item No.	I.C. Number	Part Number	Description	Rev. Ltr.	Qty Per Assy.
10-	306710-6	20195-502-000	Assy Terminator Motherboard (see Figure 6-6 for NHA)	1	1
-1	206720-5	20195-512-000	. Printed Board		1
-2	196320-6	30019-404-001	. Connector, 80 Pin Modified		1
-3	170740-5	30018-404-001	. Connector, Key 15-16		1

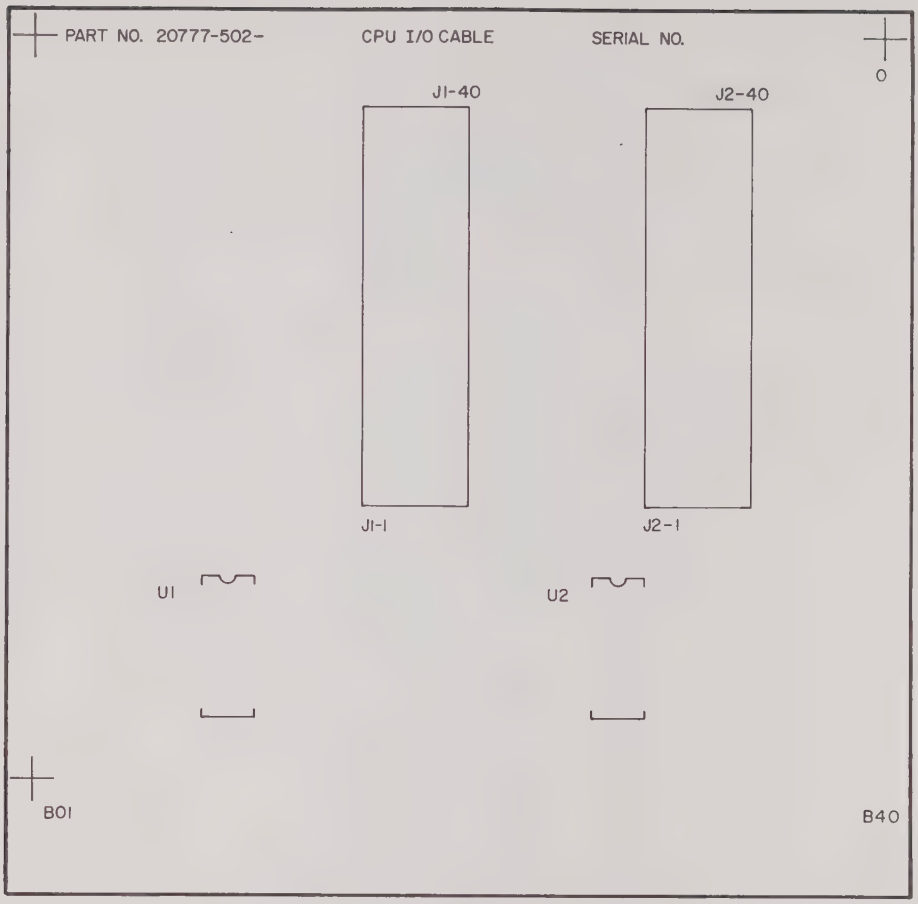

Figure 9-11. Assembly, CPU I/O Cable

Figure/ Item No.	I.C. Number	Part Number	Description	Rev. Ltr.	Qty Per Assy.
11-	413990-3	20777-502-000	Assy CPU I/O Cable (see Figure 6-6 for NHA)		
	269190-5	10033-206-002	. Cable Tie, Ref. J1, 2		1
	314370-8	30031-404-000	. Connector, PCB, Flat, 40 Pos, U1, 2		2
	413080-3	30059-404-007	. Connector, Ribbon Cable 40		2
	414210-5	30408-405-016	. Cable - Flat, 40 Cond, 28 Awg, PVC		36 IN.
	286220-9	10371-508-000	. Integrated Ck, SN74H04, U1, 2		2
	414280-8	20777-512-000	. Printed Board		1

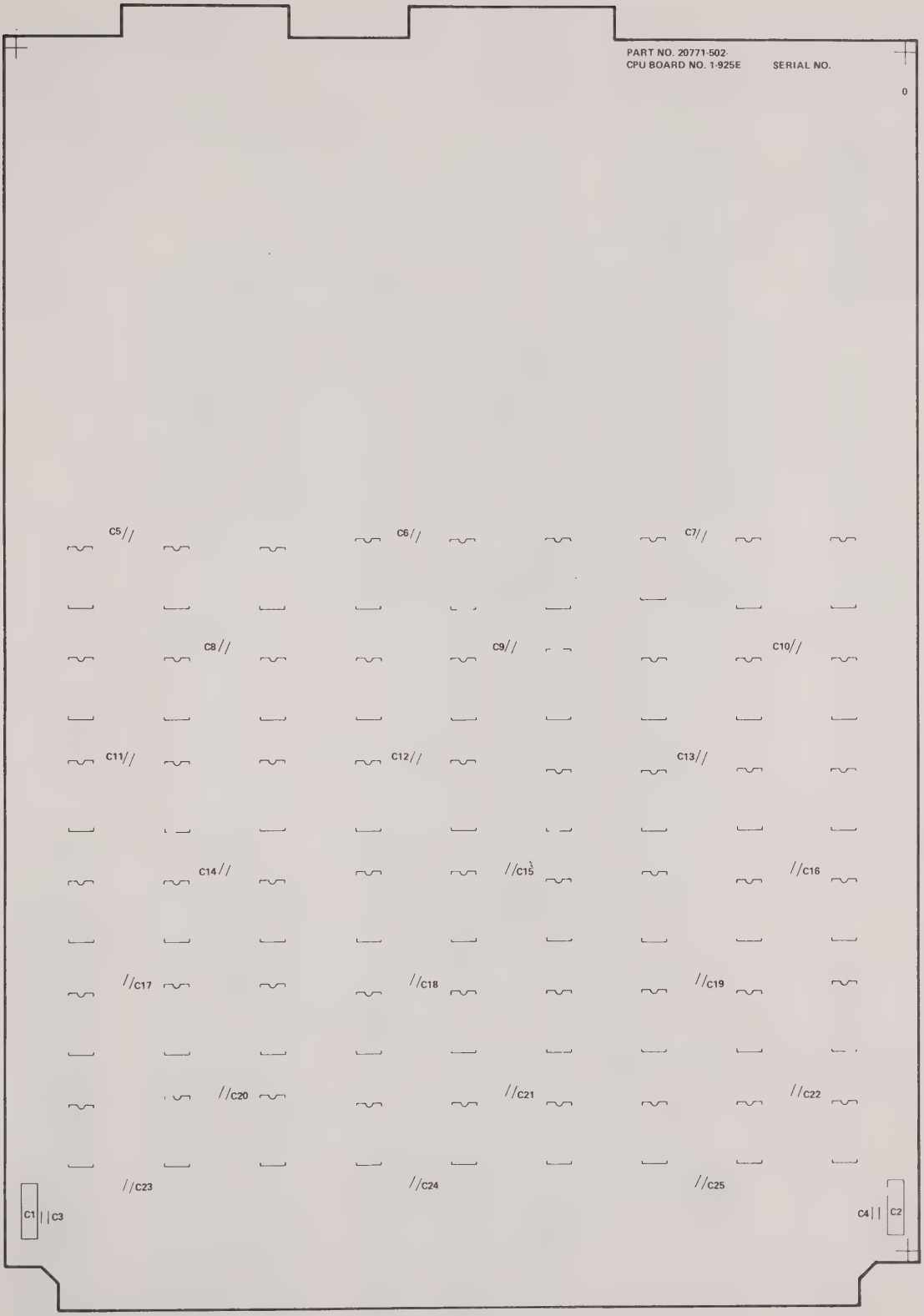

Figure 9-12. Assembly, CPU Board No. 1

Figure/ Item No.	I.C. Number	Part Number	Description	Rev. Ltr.	Qty Per Assy.
12-	425490-0	20771-502-100	Assy - CPU Board No. 1 (see Figure 6-6 for NHA)	1	1
	368450-3	60101-504-432	. Resistor Net, 4.7K Ohm, 2% Dip, 0302, 03		2
	336270-4	37012-206-009	. Ejector, Card		2
	127740-9	10202-505-328	. Capacitor, 39 μf, ±10%, 10V, C1, 2		2
	303450-1	10507-505-190	. Capacitor, 0.068 μf, +50-20%, 25V, C3 - 25		23
	379230-6	10431-508-000	. Integrated Ckt, SN74S04, 0104, 0105, 0409		3
	379400-5	10448-508-000	. Integrated Ckt, SN7438, 0204, 05, 0507		3
	409780-4	10486-508-000	. Integrated Ckt, SN74LS00, 0101, 0301, 0306, 0407, 0503, 05		6
	409770-5	10487-508-000	. Integrated Ckt, SN74LS08, 0109, 0406, 0508, 0602		4
	411500-2	10489-508-000	. Integrated Ckt, SN7428, 0106, 07, 08, 0206, 0208, 0509		7
	411510-1	10494-508-000	. Integrated Ckt, SN74LS04, 0308, 0504, 0601		3
	411540-8	10494-508-000	. Integrated Ckt, SN74LS10, 0201, 0309, 0502, 0603		4
	411550-7	10495-508-000	. Integrated Ckt, SN74LS16, 0408, 0501		2
	411600-0	10501-508-000	. Integrated Ckt, SN74LS153, 0304, 05, 0404, 05		4
	411620-8	10503-508-000	. Integrated Ckt, SN74LS109, 0307, 0401, 0402, 0403, 0506		5
	411730-5	10510-508-000	. Integrated Ckt, SN74LS85, 0, 02, 03, 0202, 03		4
	274350-8	10356-506-000	. Integrated Ckt, 9024, 0209		1
	425500-6	20771-512-100	. Printed Board		1

Figure 9-13. Assembly, M.I.B.

Figure/ Item No.	I.C. Number	Part Number	Description	Rev. Ltr.	Qty. Per Assy.
13-	414000-0	20778-502-000	Assy - M.I.B. (see Figure 6-6 for NHA)	5	1
	329940-1	11545-206-001	. Terminal, Tab, Fast-On, Ref. TB1		5
	412700-7	13054-206-005	. Terminal Block, 5 Pos., TB1		1
	050590-9	50001-206-012	. Nut, Hex 6-32		2
	171900-4	60010-206-250	. Screw, Pn Hd 6-32 x 5/8		2
	163750-3	74002-206-111	. Washer, Flat #6		2
	030070-7	74007-206-111	. Washer, Split Lock #6		2
	374210-3	50023-404-001	. Socket, 16 Pin, Solder, Re U1		1
	327520-3	30032-404-001	. Connector, PCB, 43/86, J1-10		10
	419020-3	50029-404-004	. Socket, SP, 20 Pin, JTRA, JTRB		2
	185320-9	20201-405-136	. Wire, Solid, 30 AWG, Wht		1 ft
	173390-6	10212-504-366	. Resistor, 220 Ohm, ±5%, 1/4W, R1-15		15
	437290-0	60109-504-375	. Resistor Sip, 330 Ohm, ±2%, 0.3W, R17, 19		2
	437300-7	60109-504-386	. Resistor Sip, 560 Ohm, ±2%, 0.3W, R16, 18		2
	000020-8	10126-505-384	. Capacitor, 500 LF, 30V, C1		1
	033160-3	10145-505-334	. Capacitor, 50 LF, 25V, C2		1
	446040-8	10910-406-000	. Wire List, Cont No. 818		1
	0336909	10201-506-000	. Diode, 1N914, CR1		1
	341450-5	10421-508-000	. Integrated Ckt, 9615, U1		1
	414530-6	20778-512-000	. Printed Bd.		1

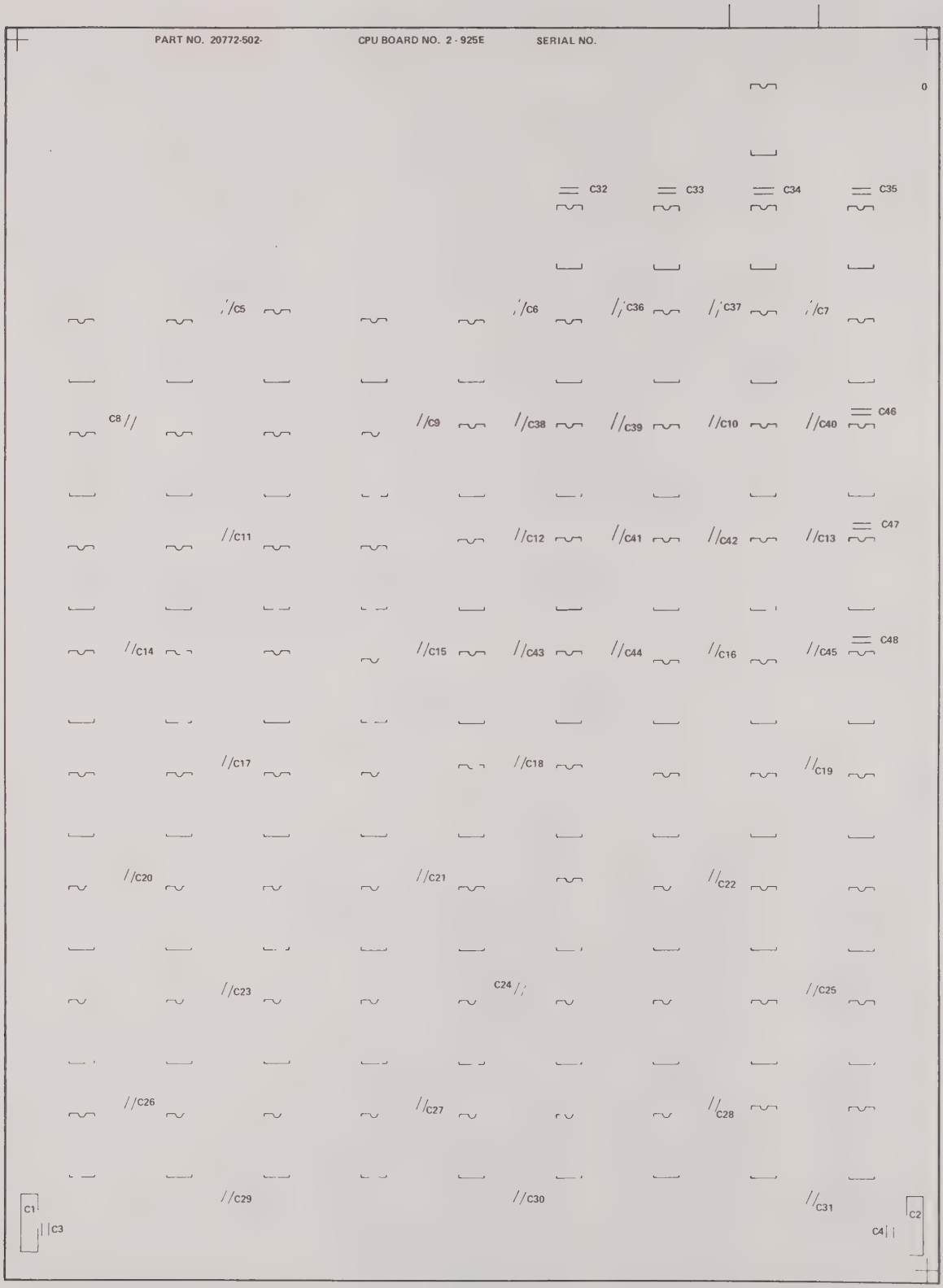

Figure 9-14. Assembly, CPU Board No. 2

Figure/ Item No.	I.C. Number	Part Number	Description	Rev. Ltr.	Qty. Per Assy.
14-	414020-8	20772-502-000	Assy - CPU Board No. 2 (see Figure 6-6 for NHA)	2	1
	336270-4	37012-206-009	. Ejector, Card		2
	127740-9	10202-505-328	. Capacitor, 39 μf, ±10%, 10V, C1, 2		2
	303450-1	10507-505-190	. Capacitor, 0.068 μf, +50 -20%, 25V, C3 thru 48		46
	406480-4	60101-504-382	. Resistor Netwk, 470 Ohm, ±2%, 0809		1
	330900-2	60101-504-400	. Resistor Netwk, 1.0K Ohm, ±2%, 0702		1
	286270-4	10376-508-000	. Integrated Ckt, SN74H21, 0101, 0106, 0303, 0307, 0805		5
	379230-6	10431-508-000	. Integrated Ckt, SN74S04, 0102, 03, 0206, 0309, 0404, 0906-08		8
	379340-3	10444-508-000	. Integrated Ckt, SN74S10, 0201, 0203, 0204, 0301		4
	392070-9	10452-508-000	. Integrated Ckt, SN74175, 0501, 0502, 0503		3
	391100-5	10474-508-000	. Integrated Ckt, SN74S00, 0104, 0302, 0304, 0305, 0401, 0504		6
	384210-1	10478-508-000	. Integrated Ckt, SN74S258, 0405		1
	391110-4	10480-508-000	. Integrated Ckt, SN74S20, 0105, 0202, 0402, 0403		4
	409780-4	10486-508-000	. Integrated Ckt, SN74LS00, 0107, 0209, 0604, 0703, 0704, 0806		6
	409770-5	10487-506-000	. Integrated Ckt, SN74LS08, 0701		1
	411510-1	10491-508-000	. Integrated Ckt, SN74LS04, 0207, 0409		2
	411530-9	10495-508-000	. Integrated Ckt, SN74S08, 0205		1
	411540-8	10494-508-000	. Integrated Ckt, SN74LS10, 0603, 0802		2
	411550-7	10495-508-000	. Integrated Ckt, SN74LS11, 0601, 0602		2
	411600-0	10501-508-000	. Integrated Ckt, SN74LS153, 0505		1
	411610-9	10502-508-000	. Integrated Ckt, SN74LS151, 0108		1
	411620-8	10503-508-000	. Integrated Ckt, SN74LS109, 0109, 0605, 0803		3
	411720-6	10511-508-000	. Integrated Ckt, SN74S175, 0807, 0808		2
	411710-7	10512-508-000	. Integrated Ckt, SN74S03, 0208, 0308, 0408, 0507, 0508, 0909		6
	411690-1	10513-508-000	. Integrated Ckt, SN74S05, 0407		1
	411680-2	10515-508-000	. Integrated Ckt, SN74LS02, 0804		1
	301050-1	10399-508-000	. Integrated Ckt, 9318, 0705		1
	414680-9	70110-508-004	. Integrated Ckt, ROM, 0706		1
	414670-0	70110-508-003	. Integrated Ckt, ROM, 0709		1
	414730-2	70111-508-002	. Integrated Ckt, ROM, 0607		1
	414720-3	70111-508-001	. Integrated Ckt, ROM, 0608		1
	414660-1	70110-508-002	. Integrated Ckt, ROM, 0707		1
	414650-2	70110-508-001	. Integrated Ckt, ROM, 0708		1
	379500-7	10438-508-000	. Integrated Ckt, SN74S138, 0306, 0406, 0506, 0606, 0509, 0609		6
	415860-6	70114-508-001	. Integrated Ckt, ROM, 1008		1
	341750-8	50015-404-101	. Socket, IC, Solder, 16 Pin, 0405, 0607, 08, 0706-09, 0802-08, 1008		10
	341740-9	50009-404-101	. Socket, Solder, 14 Pin, 0208, 0308, 0407, 08, 0507, 08, 0909		7

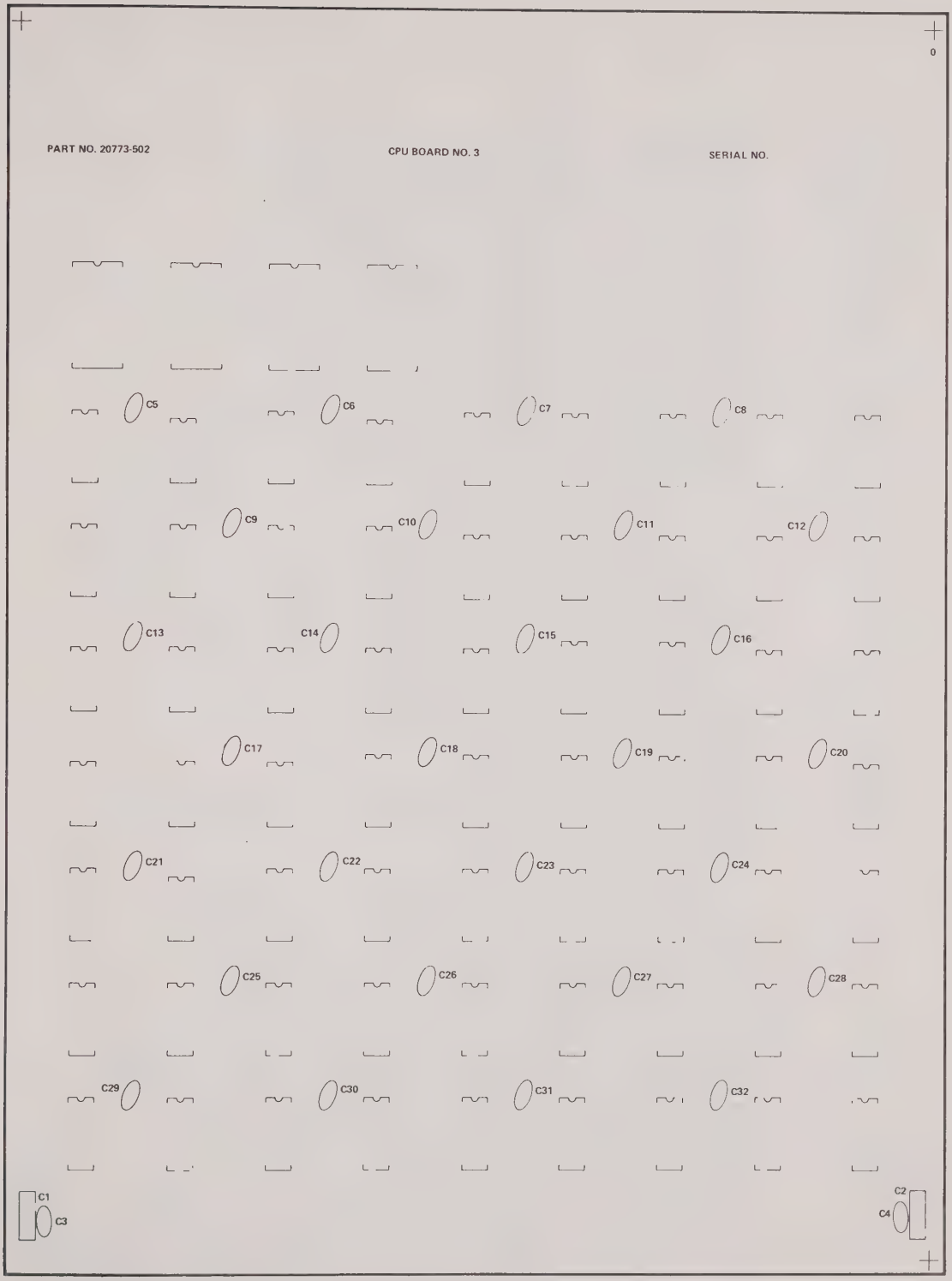

Figure 9-15. Assembly, CPU Board No. 3

Figure/ Item No.	I.C. Number	Part Number	Description	Rev. Ltr.	Qty. Per Assy.
15-	414030-7	20773-502-000	Assy - CPU Board No. 3 (see Figure 6-6 for NHA)	1	1
	127740-5	10202-505-328	. Capacitor, 39 μf, ±10%, 10V, C1, 2		2
	303450-1	10507-505-190	. Capacitor, 0.068 μf, +50 -20%, 25V, C3-32		30
	411510-1	10491-508-000	. Integrated Ckt, SN74LS04, 0607		1
	379230-6	10431-508-000	. Integrated Ckt, SN74S04, 0403, 0509		2
	391100-5	10474-508-000	. Integrated Ckt, SN74S00, 0402, 0503, 04, 0608, 09		5
	391110-4	10480-508-000	. Integrated Ckt, SN74S20, 0401, 0606		2
	411530-9	10493-508-000	. Integrated Ckt, SN74S08, 0302, 0508, 0605, 0702, 04		5
	411540-8	10494-508-000	. Integrated Ckt, SN74LS10, 0505		1
	411550-7	10495-508-000	. Integrated Ckt, SN74LS11, 0409		1
	411570-5	10497-508-000	. Integrated Ckt, SN74H55, 0501, 02		2
	411790-9	10498-508-000	. Integrated Ckt, SN74LS157, 0308, 09		2
	411580-4	10499-508-000	. Integrated Ckt, SN74S81, 0801, 02, 03, 04		4
	411590-3	10500-508-000	. Integrated Ckt, SN74S82, 0703		1
	411600-0	10501-508-000	. Integrated Ckt, SN74LS153, 0201, 08, 09, 0404, 05, 06, 07, 08, 0705		9
	411610-9	10502-508-000	. Integrated Ckt, SN74LS151, 0101, 02, 03, 04, 05, 06, 07, 08, 09, 0202, 03, 04, 05, 06, 07		15
	411620-8	10503-508-000	. Integrated Ckt, SN74LS109, 0506, 07		2
	411630-7	10504-508-000	. Integrated Ckt, SN74LS195, 0601, 02, 03, 04		4
	411640-6	10505-508-000	. Integrated Ckt, SN74LS174, 0303, 04, 06, 07		4
	414700-5	70110-508-006	. Integrated Ckt, ROM, 0706		1
	414780-7	70110-508-009	. Integrated Ckt, ROM, 0707		1
	414790-6	70110-508-010	. Integrated Ckt, ROM, 0708		1
	414800-3	70110-508-011	. Integrated Ckt, ROM, 0709		1
	414150-3	20773-512-000	. Printed Board		1
	336270-4	37012-206-009	. Ejector, Card		2
	341750-8	50015-404-101	. Socket, IC Solder, 16 Pin, 0706, 07, 08, 09		4

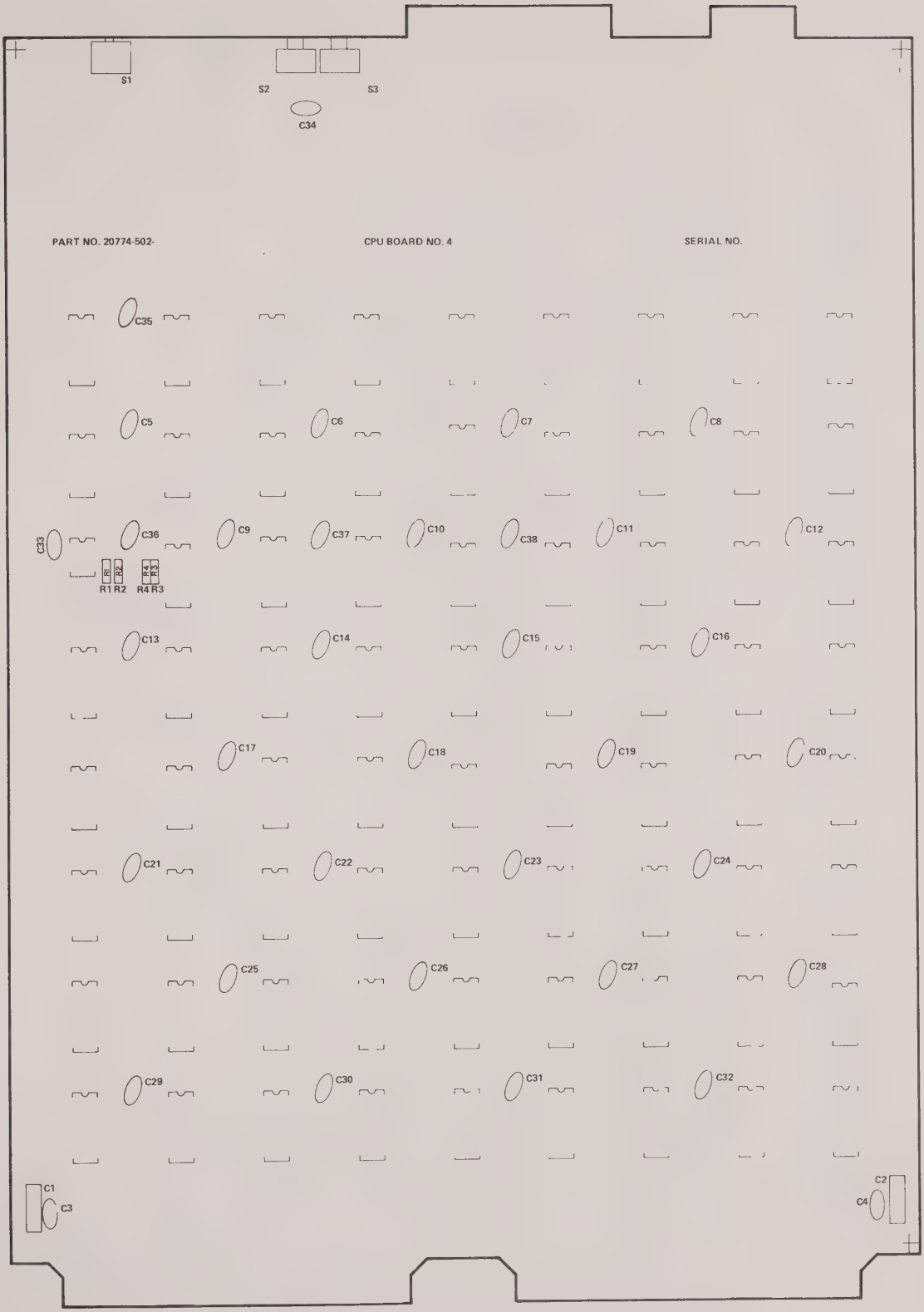

Figure 9-16. Assembly, CPU Board No. 4

Figure/ Item No.	I.C. Number	Part Number	Description	Rev. Ltr.	Qty. Per Assy.
16-	414040-6	20774-502-000	Assy - CPU Board No. 4 (see Figure 6-6 for NHA)	2	1
	336270-4	37012-206-009	. Ejector, Card		2
	142000-9	11001-206-001	. Jumper - Insulated, W1		1
	245950-1	10112-304-001	. Switch, S2, S3		2
	403250-4	10424-304-001	. Switch, S1		1
	413220-5	90105-304-020	. Oscillator, K1091A, 20 MHz, C702		1
	230970-6	10212-504-373	. Resistor, 300 Ohm, ±5%, 1/4W, R4		1
	173420-1	10212-504-394	. Resistor, 820 Ohm, ±5%, 1/4W, R2		1
	109180-0	10212-504-432	. Resistor, 4.7K Ohm, ±5%, 1/4W, R1		1
	330900-2	60101-504-400	. Resistor Netwk, 1.0K Ohm, ±2%, 0704		1
	116630-5	10212-504-388	. Resistor, 620 Ohm, ±5%, 1/4W, R3		1
	127740-9	10202-505-328	. Capacitor, 39 μf, ±10%, 10V, C1, 2		2
	226070-1	10503-505-500	. Capacitor, 0.1 μf, ±10%, 100V, C33, 34		2
	303450-1	10507-505-190	. Capacitor, 0.068 μf, +50 -20%, 25V, C3 – 32, C35 – 38		34
	286400-7	10388-508-000	. Integrated Ckt, SN74180, 0407, 0404		2
	379340-3	10444-508-000	. Integrated Ckt, SN74S10, 0602		1
	391100-5	10474-508-000	. Integrated Ckt, SN74S00, 0703		1
	409180-4	10486-508-000	. Integrated Ckt, SN74LS00, 0605, 0606, 0607, 0608, 0707		5
	409770-5	10487-508-000	. Integrated Ckt, SN74LS08, 0706		1
	411760-2	10490-508-000	. Integrated Ckt, SN74LS298, 0301, 0302, 0303, 0305, 0306, 0307		6
	411510-1	10491-508-000	. Integrated Ckt, SN74LS04, 0609		1
	411520-0	10492-508-000	. Integrated Ckt, SN74LS05, 0401, 0402, 0405, 0406		4
	411540-8	10494-508-000	. Integrated Ckt, SN74LS10, 0708		1
	411560-6	10496-508-000	. Integrated Ckt, SN74LS51, 0209		1
	411600-0	10501-508-000	. Integrated Ckt, SN74LS153, 0408, 0505, 0506, 0507, 0508, 0509		6
	411610-9	10502-508-000	. Integrated Ckt, SN74LS151, 0101, 0102, 0103, 0104, 0105, 0106, 0107, 0108, 0109, 0502, 0503, 0504		12
	411620-8	10503-508-000	. Integrated Ckt, SN74LS109, 0309, 0409		2
	411640-6	10505-508-000	. Integrated Ckt, SN74LS174, 0201, 0202, 0203, 0204, 0205, 0206, 0207, 0208, 0304, 0308		10
	411660-4	10507-508-000	. Integrated Ckt, SN74120, 0801		1
	331920-9	10411-508-000	. Integrated Ckt, SN74161, 0501		1
	411670-3	10509-508-000	. Integrated Ckt, SN74LS138, 0709		1
	414690-8	70110-508-005	. Integrated Ckt, ROM, 0807		1
	414710-4	70110-508-007	. Integrated Ckt, ROM, 0808		1
	414770-8	70110-508-008	. Integrated Ckt, ROM, 0809		1
	366490-1	30311-508-000	. Integrated Ckt, NE555V, 0601		1
	415480-3	10522-508-000	. Integrated Ckt, SN74S163, 0705		1
	415490-2	10521-508-000	. Integrated Ckt, 9S109, 0603, 0604, 0806		3
	379230-6	10431-508-000	. Integrated Ckt, SN74S04, 0701		1
	341750-8	50015-404-101	. Socket, IC, Solder 16 Pin, 0807-0809		3
	414330-1	20774-512-000	. Printed Board		1

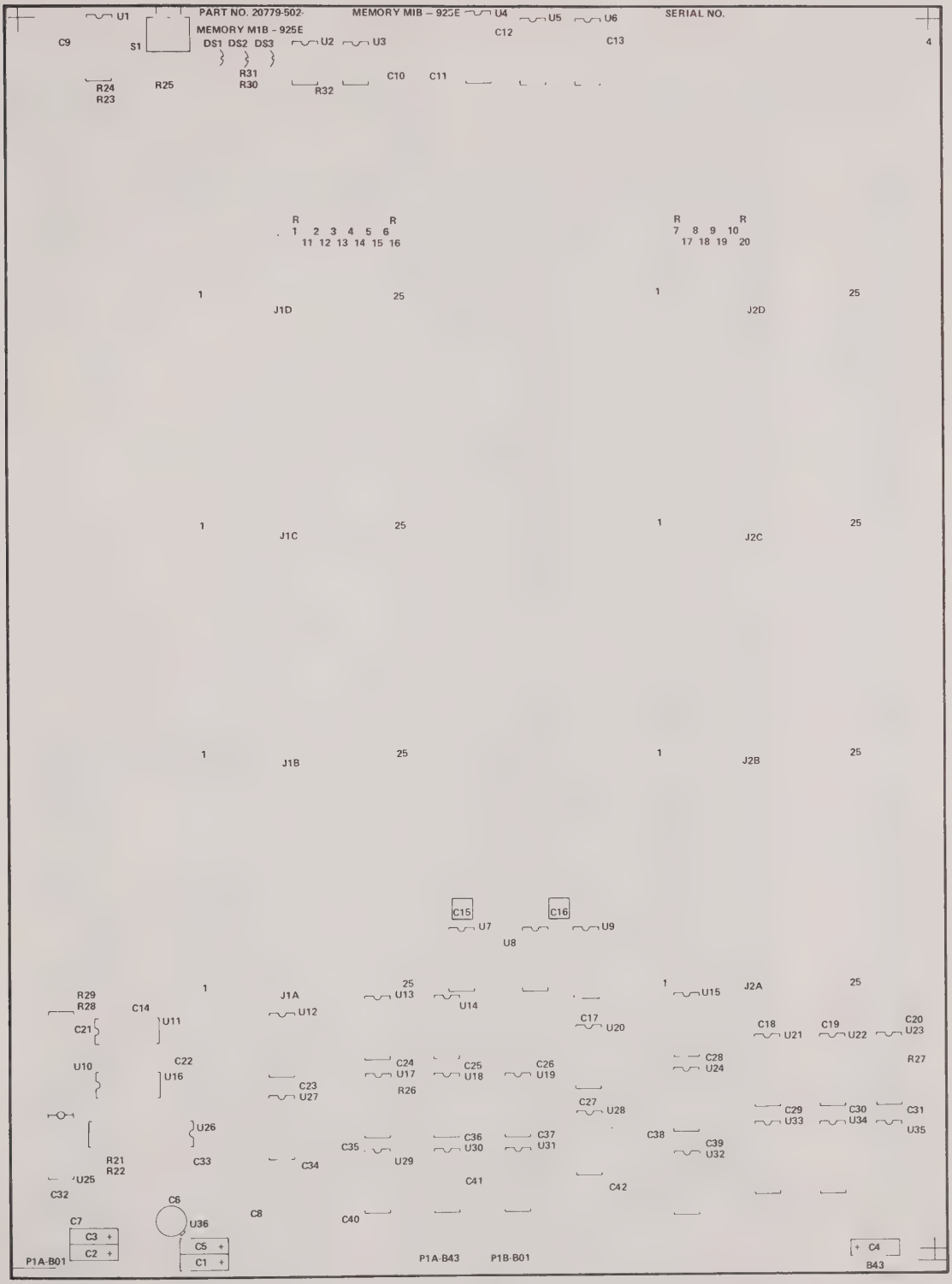

Figure 9-17. Assembly, Memory M.I.B.

Figure/ Item No.	I.C. Number	Part Number	Description	Rev. Ltr.	Qty. Per Assy.
17-	414900-1	20779-502-100	Assy - Memory M1B, (see Figure 6-6 for NHA)	4	1
	336270-4	37012-206-009	. Ejector, Card		2
	166260-0	12012-206-001	. Transistor Mount, Ref. U36		1
	029550-1	60010-206-170	. Screw, 4-40, Pan Hd		6
	161650-7	50001-206-008	. Nut #4, Hex		6
	091380-6	72002-206-001	. Spacer, Round Thd		2
	149140-6	74002-206-071	. Washer, #4, Flat		2
	030060-8	74007-206-071	. Washer, #4, Split		6
	419240-7	14185-204-000	. Stiffener		2
	245950-1	10112-304-001	. Switch, 7101A, S1		1
	413210-6	20001-305-219	. Delay Line, Phombus TE230-10, U10, 26		2
	413250-2	30060-404-001	. Connector, B409U025, J1A, B, C, D, J2A, B, C, D		8
	414740-1	20775-502-000	. Assy - Memory, 925E		1
	176480-2	10212-504-352	. Resistor, 110 Ohm, ±5%, 1/4W, R1 – 10		10
	108930-4	10212-504-362	. Resistor, 180 Ohm, ±5%, 1/4W, R22, 29		2
	173390-6	10212-504-366	. Resistor, 220 Ohm, ±5%, 1/4W, R30 – 32		3
	079540-1	10212-504-400	. Resistor, 1K Ohm, ±5%, 1/4W, R25 – 27		3
	109180-0	10212-504-432	. Resistor, 4.7K Ohm, ±5%, 1/4W, R23, 24		2
	116610-7	10212-504-371	. Resistor, 270 Ohm, ±5%, 1/4W, R11 – 20		10
	173410-2	10212-504-386	. Resistor, 560 Ohm, ±5%, 1/4W, R21, 28		2
	000550-4	10204-505-308	. Capacitor, 15 μf, ±10%, 20V, C1, 2		2
	127740-9	10202-505-328	. Capacitor, 39 μf, ±10%, 10V, C3, 4, 5		3
	226370-5	10502-505-450	. Capacitor, 0.01 μf, ±10%, 100V, C15, 16, 10, 11		4
	359530-3	10507-505-150	. Capacitor, 0.01 μf, +80 -20%, 25V, C6 – 9, 12 – 14, 17 – 42		33
	402930-2	40106-504-450	. Resistor Ntwk, 10K Ohm, ±2%, U9		1
	391110-4	10480-508-000	. Integrated Ckt, SN74S20, U14		1
	331920-9	10411-508-000	. Integrated Ckt, SN74161N, U21 – 23		3
	369670-5	10429-508-000	. Integrated Ckt, SN75452BP, U2, 3		2
	379230-6	10431-508-000	. Integrated Ckt, SN74S04, U8, 24		2
	379300-7	10438-508-000	. Integrated Ckt, SN74S138, U4		1
	379340-3	10444-508-000	. Integrated Ckt, SN74S10, U12, 18		2
	379390-8	10447-508-000	. Integrated Ckt, SN74S7, U19, 31, 32		3
	391100-5	10474-508-000	. Integrated Ckt, SN74S00, U5, 6, 13, 15, 30		5
	406610-6	10481-508-000	. Integrated Ckt, SN74S74, U1, 17, 27, 29		4
	411530-9	10493-508-000	. Integrated Ckt, SN74S08, U7, 25		2
	397540-6	10519-508-000	. Integrated Ckt, SN74S86, U11, 16, 28		3
	414630-4	10518-508-000	. Integrated Ckt, SN74S153, U33 – 35		3
	391160-9	10470-508-000	. Integrated Ckt, SN74S280, U20		1
	413240-3	30115-508-000	. Voltage Reg., LM320H-5.0, U36		1
	414480-4	20779-512-000	. Printed Board		1
	344450-2	10503-703-001	. Lamp - Led, MV5025, DS1, 2, 3		3

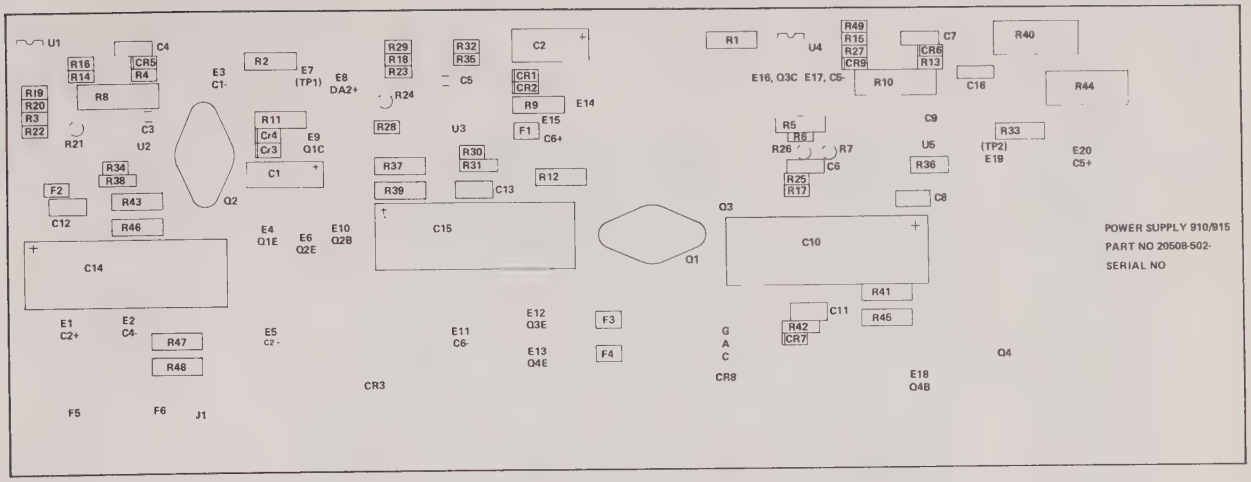

Figure 9-18. Assembly, Power Supply 910/915

Figure/ Item No.	I.C. Number	Part Number	Description	Rev. Ltr.	Qty. Per Assy.
18-	329540-9	20508-502-000	Assy - Power Supply 910/915 (see Figure 6-5 for NHA)	7	1
	335160-8	40106-304-023	. Fuse, Sub-Min - 15A, F2, 3, 4		3
	329930-2	13054-206-011	. Terminal Block, 11 Pos, J1		1
	033810-4	10502-206-001	. Heat Sink, UP1-To 3LB, Ref. Q3, 4		2
	329940-1	11545-206-001	. Tab - Terminal, 2 Sides 90°, Ref. J1, E10, E18		13
	388240-4	13735-204-000	. Label		1
	196290-1	40002-206-017	. Eyelet, Ref. E1 – E6, E8 – 18, E20		18
	258900-0	43002-206-002	. Fuse Holder, Ref. F5, F6		2
	275090-9	40102-304-031	. Fuse, 3AG, Slo-Blo, 6-1/4A, F5, 6		2
	329820-5	40106-304-022	. Fuse, Sub-Min. 8 Amp, F1		1
	018480-4	80014-404-002	. Tab - Terminal, 1 Side 90°, E1 – 6, E8, E9, E11 – 17, E20		16
	079510-4	10212-504-354	. Resistor, 120 Ohm, ±5%, 1/4W, R4		1
	109110-7	10212-504-378	. Resistor, 380 Ohm, ±5%, 1/4W, R32		1
	079520-3	10212-504-382	. Resistor, 470 Ohm, ±5%, 1/4W, R14, 25, 30, 34		4
	173420-1	10212-504-394	. Resistor, 820 Ohm, ±5%, 1/4W, R22, 28		2
	079540-1	10212-504-400	. Resistor, 1K Ohm, ±5%, 1/4W, R13, 20, 23		3
	079560-9	10212-504-408	. Resistor, 1.5K Ohm, ±5%, 1/4W, R27		1
	079600-3	10212-504-425	. Resistor, 3.3K Ohm, ±5%, 1/4W, R35		1
	109180-0	10212-504-432	. Resistor, 4.7K Ohm, ±5%, 1/4W, R15, 16		2
	079630-0	10212-504-450	. Resistor, 10K Ohm, ±5%, 1/4W, R18, R49		2
	108950-7	10212-504-454	. Resistor, 12K Ohm, ±5%, 1/4W, R6		1
	109100-8	10212-504-475	. Resistor, 33K Ohm, ±5%, 1/4W, R19, 29		2
	109240-2	10212-504-490	. Resistor, 68K Ohm, ±5%, 1/4W, R3		1
	140910-1	10212-504-512	. Resistor, 180K Ohm, ±5%, 1/4W, R17		1
	002300-2	10222-504-316	. Resistor, 22 Ohm, ±5%, 1/2W, R42		1
	002400-3	10222-504-358	. Resistor, 150 Ohm, ±5%, 1/2W, R31, 36, 38		3

Figure/ Item No.	I.C. Number	Part Number	Description	Rev. Ltr.	Qty. Per Assy.
18-	186510-4	10501-504-200	. Resistor, 0.1 Ohm, ±5%, 2W, R43, 46		2
	102420-7	10501-504-250	. Resistor, 1 Ohm, ±5%, 2W, R37, 39		2
	228450-3	10501-504-416	. Resistor, 2.2K Ohm, ±5%, 2W, R1, 2, 5, 12		4
	288610-9	10501-504-390	. Resistor, 680 Ohm, ±5%, 2W, R9, 11		2
	173520-8	10501-504-354	. Resistor, 120 Ohm, ±5%, 2W, R33, 41, 45		3
	196090-5	10501-504-366	. Resistor, 220 Ohm, ±5%, 2W, R47, 48		2
	329760-3	10527-504-308	. Resistor, 15 Ohm, ±5%, 5W, R40, 44		2
	329770-2	10528-504-150	. Resistor, 0.01 Ohm, ±5%, 5W, R8, 10		2
	190100-8	40204-504-384	. Potentiometer, 500 Ohm, 1/2W, R7, 21, 24, 26		4
	124820-2	10124-505-404	. Capacitor, 1200 μf, -10% +75%, 15V, C10		1
	000020-8	10126-505-384	. Capacitor, 500 μf, -10% +75%, 30V, C14, 15		2
	033160-3	10145-505-334	. Capacitor, 50 μf, -10% +75%, 25V, C1, C2		2
	133670-0	10502-505-382	. Capacitor, 470 pf, ±10%, 200V, C3, 5		2
	265670-0	10503-505-432	. Capacitor, 4700 pf, ±10%, 200V, C9		1
	303450-1	10507-505-190	. Capacitor, 0.068 μf, +50% -20%, 25V, C4, 6, 7, 8, 11, 12, 13, 16		8
	033690-9	10201-506-000	. Diode, SI, 45V, 200 MA, CR2, 4, 5, 6, 9		5
	168870-4	30211-506-284	. Diode, Zener, 5.1V, 5%, 0.4W, CR7		1
	000870-6	30211-506-288	. Diode, Zener, 6.2V, 5%, 0.4W, CR1, 3		2
	330110-8	50107-506-323	. SCR, 30V, 16A, CR8		1
	061920-5	20403-507-000	. Transistor, NPN, 60V, 15A, Q3, 4		2
	092010-8	20404-507-000	. Transistor, NPN, 60V, 4A, Q1, 2		2
	176360-6	30104-508-000	. Integrated Ckt, Volt. Regulator, U2, 3, 5		3
	272530-7	30307-508-000	. Integrated Ckt, Oper. Ampl, U1, 4		2
	337570-6	11548-206-001	. Tab - Terminal, 2 Sides 45°, Ref. J1 – 4, J1 – 9, J1 – 11		3
	173630-5	50003-206-008	. Nut, Hex #4, Sm. Pattern, Ref. CR8		1
	029520-4	60010-206-167	. Screw, Pan Head, 4-40 x 3/8, Ref. CR8		1
	149140-6	74002-206-071	. Washer, Flat #4, Ref. CR8		1
	030060-8	74007-206-071	. Washer, Split #4, Ref. CR8		1
	322270-0	10513-206-000	. Heat Sink, PA2-1U, Ref. [R8		1
	329550-8	20508-512-000	. Printed Board		1
	014030-1	20101-405-016	. Wire, Tinned, 18 AWG		1 ft.
	173550-5	50401-405-014	. Sleeving, Teflon, No. 18		10 in.

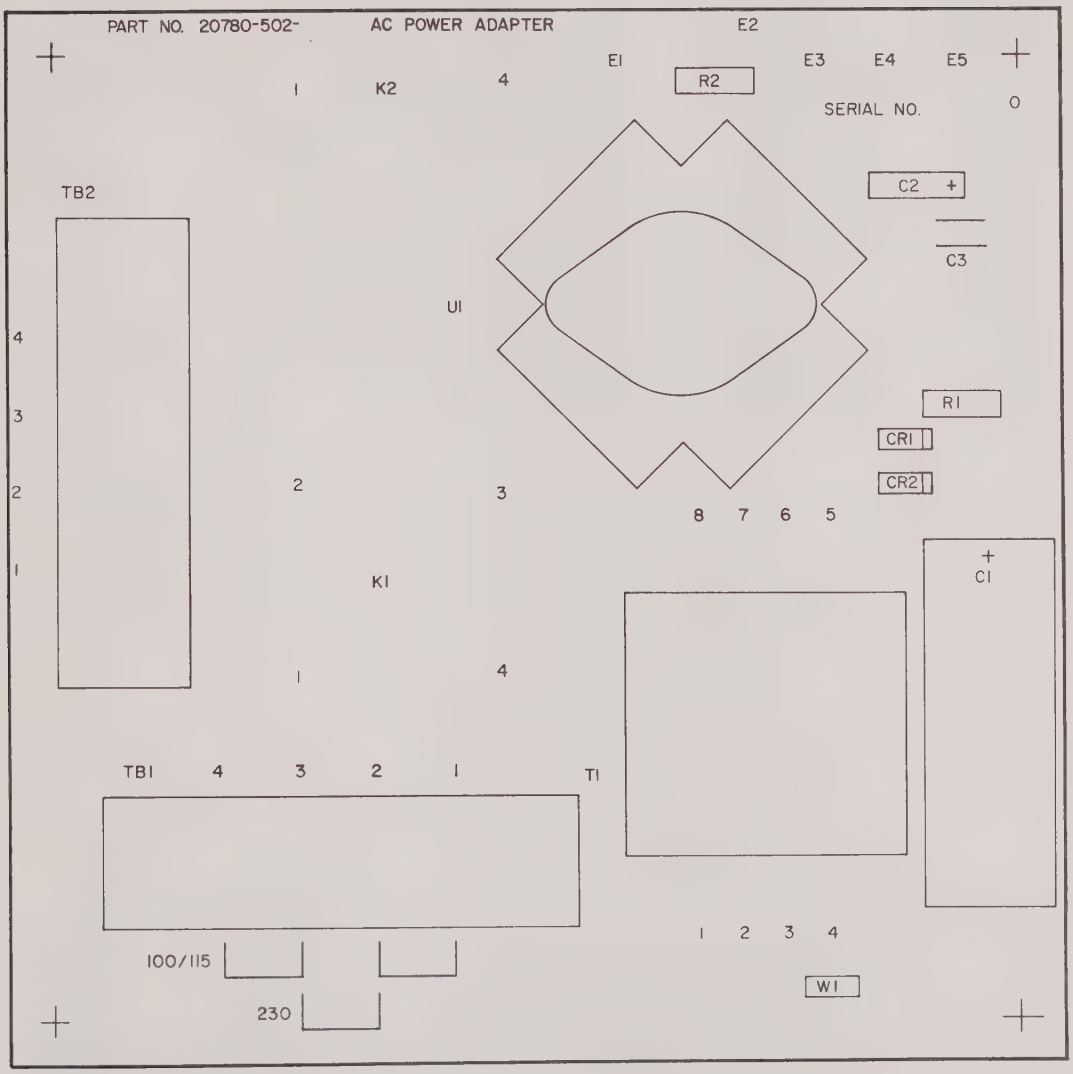

Figure 9-19. Assembly, AC Power Adapter

Figure/ Item No.	I.C. Number	Part Number	Description	Rev. Ltr.	Qty Per Assy.
19-	419890-9	20780-502-011	Assy - AC Power Adapter (see Figure 6-4 for NHA	2	1
	033310-4	10502-206-001	. Dissipator, Up-T03 CB		1
	142000-9	11001-206-001	. Jumper, Insulated, W1		1
	026830-0	12009-206-002	. MICA Insulator, Ref. U1		
	397230-4	12536-206-000	. Socket, Component Lead, Ref. U1		
	421200-7	13054-206-004	. Terminal Block, 4 Pos, TB1, 2		2
	205920-2	80305-404-002	. Contact - Female, Ref. J1, 3		4
	274560-2	80310-404-004	. Housing - Rcpt, Ears, Tabs, 2 Cont, J1		1
	221550-7	80314-404-004	. Housing - Rcpt, Ears, Tabs, 4 Cont, J3		1
	401010-4	10178-403-000	. Transformer, T1		1
	405820-2	10207-405-140	. Wire - PVC, 22 Awg, Wht		3 FT
	002450-5	10222-504-375	. Resistor, 330 Ohm, ±5%, 1/2W, R2		1
	002550-2	10222-504-416	. Resistor, 2.2K Ohm, ±5%, 1/2W, R1		1
	124820-2	10124-505-404	. Capacitor, 1200 μf, 15V, C1		1
	127740-9	10202-505-328	. Capacitor, 39 μf, ±10%, 10V, C2		1
	303450-1	10507-505-190	. Capacitor, 0.068 μf, +50 - 20%, 25V, C3		1
	068890-3	20101-506-334	. Diode, IN4001, CR1, 2		2
	350250-7	30402-508-000	. Integrated Ckt, LM309K, U1		
	421040-7	20780-512-000	. PB		1

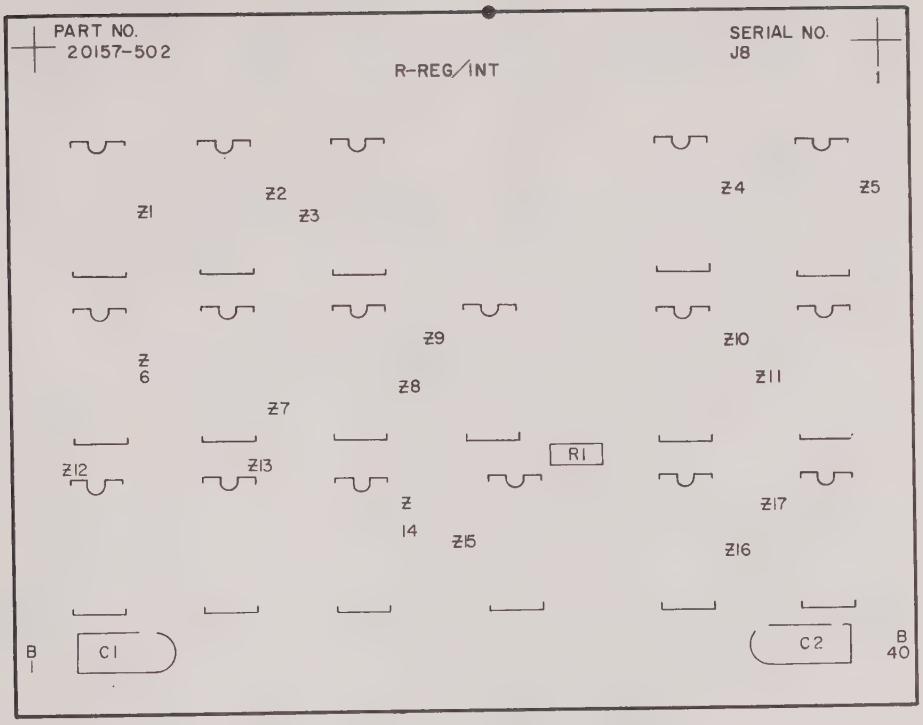

Figure 9-20. Assembly, R-REG/INT (J8)

Figure/ Item No.	I.C. Number	Part Number	Description	Rev. Ltr.	Qty Per Assy.
20-	193740-8	20157-502-000	Assy-R-Reg/Int (J8) (see Figure 6-2 for NHA)	2	1
	127740-9	10202-505-328	. Capacitor, 39 μf, ±10%, 10V, C1, C2		2
	208120-6	10325-508-000	. Integrated Ckt, SM113, Z5, Z11, Z17		3
	154230-7	10315-508-000	. Integrated Ckt, SF112, Z15		1
	168720-1	10331-508-000	. Integrated Ckt, SG382, Z10, Z14, Z16		3
	154310-7	10321-508-000	. Integrated Ckt, SG322, Z8, Z13		2
	154280-2	10318-508-000	. Integrated Ckt, SG242, Z1		1
	150280-6	10307-508-000	. Integrated Ckt, SG222, Z2, Z3, Z7		3
	154260-4	10316-508-000	. Integrated Ckt, SG202, Z4, Z9		2
	111440-4	10310-508-000	. Integrated Ckt, SG162, Z6, 12		2
	079540-1	10212-504-400	. Resistor, 1K Ohm, ±5%, 1/4W, R1		1
	212680-3	20157-512-000	. Printed Board		1

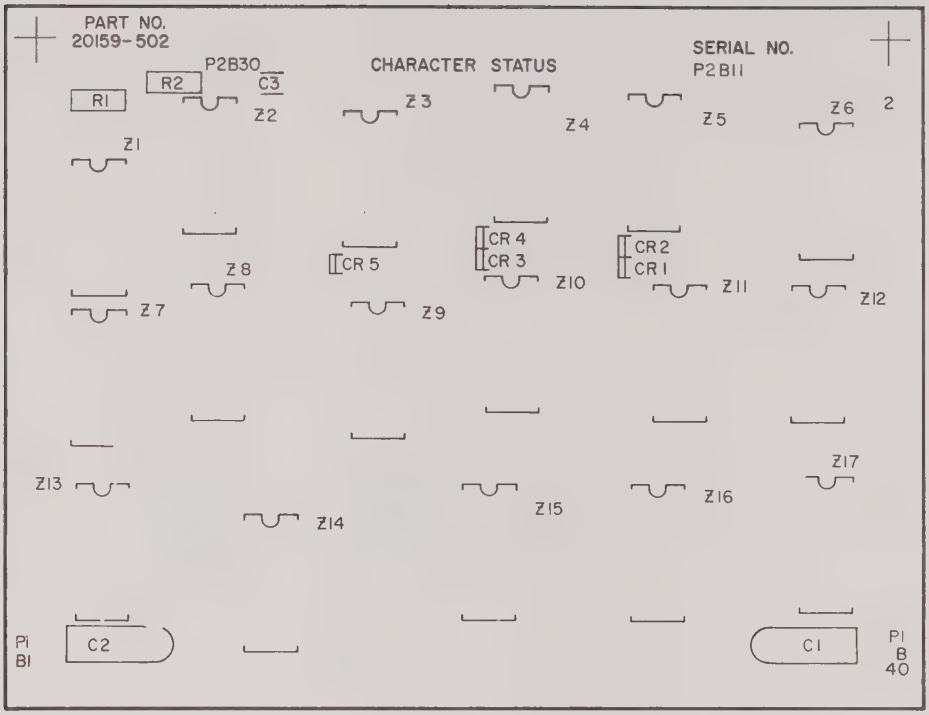

Figure 9-21. Assembly, Character Status (J10)

Figure/ Item No.	I.C. Number	Part Number	Description	Rev. Ltr.	Qty Per Assy.
21-	419080-7	20159-502-100	Assy - Character Status (J10) (see Figure 6-2 for NHA)	2	1
	079610-2	10212-504-436	. Resistor, 5.6K Ohm, ±5%, 1/4W, R2		.1
	079540-1	10212-504-400	. Resistor, 1K Ohm, ±5%, 1/4W, R1		1
	127740-9	10202-505-328	. Capacitor, 39 μf, 10%, 10V, C1, C2		2
	225260-9	10502-505-325	. Capacitor, 33 pf, ±10%, 200V, C3		1
	033690-9	10301-506-000	. Diode, CR1, 2, 3, 4, 5		5
	111440-4	10310-508-000	. Integrated Ckt, Z4, 5		2
	150280-6	10307-508-000	. Integrated Ckt, Z7, 12		2
	154230-7	10315-508-000	. Integrated Ckt, Z8, 9, 10, 15		4
	154260-4	10316-508-000	. Integrated Ckt, Z1		1
	154280-2	10318-508-000	. Integrated Ckt, Z6, 17		2
	154310-7	10321-508-000	. Integrated Ckt, Z13, 16		2
	168720-1	10331-508-000	. Integrated Ckt, Z3, 11, 14		3
	141870-6	10308-508-000	. Integrated Ckt, Z2		1
	419130-0	20159-512-100	. Printed Board		1

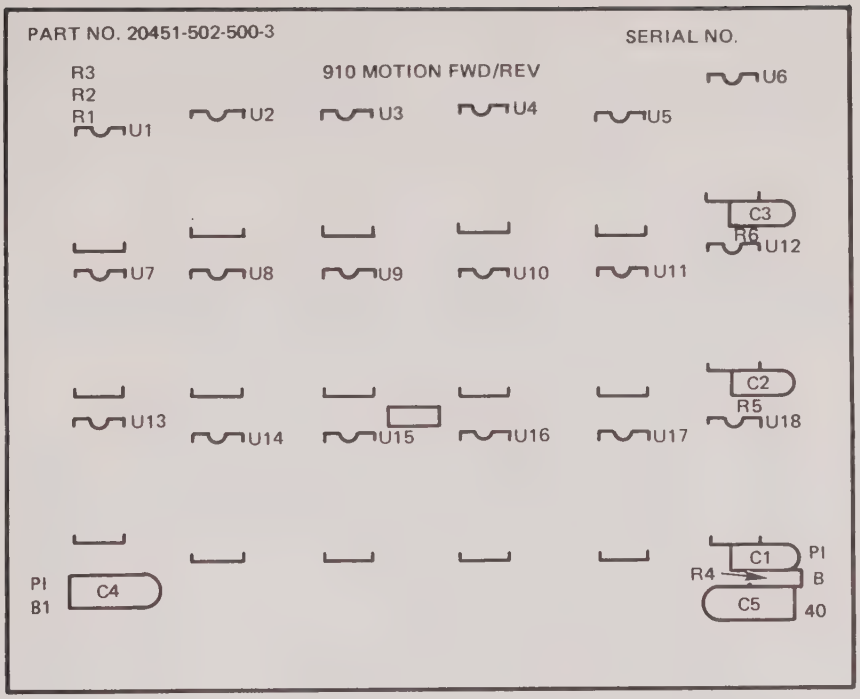

Figure 9-22. Assembly, 915 Motion FWD/REV

Figure/ Item No.	I.C. Number	Part Number	Description	Rev. Ltr.	Qty Per Assy.
22-	325800-1	20451-502-500	Assy - 915 Motion Fwd/Rev (see Figure 6-2 for NHA)	3	1
	173390-6	10212-504-366	. Resistor, 220 Ohm, ±5%, 1/4W, R1, 2, 3		3
	109120-6	10212-504-478	. Resistor, 39K Ohm, ±5%, 1/4W, R4		1
	109050-5	10212-504-466	. Resistor, 22K Ohm, ±5%, 1/4W, R5, 6		2
	079540-1	10212-504-400	. Resistor, 1K Ohm, ±5%, 1/4W, R7		1
	289570-4	10506-505-190	. Capacitor, 0.068 μf, ±5%, 100V, C1		1
	068640-2	10205-505-208	. Capacitor, 0.15 ± 10%, 35V, C3, C2		2
	127740-9	10202-505-328	. Capacitor, 39 μf, ±10%, 10V, C4, C5		2
	150280-6	10307-508-000	. Integrated Ckt, U5, 14, 17		3
	141870-6	10308-508-000	. Integrated Ckt, U6, 12, 18		3
	154230-7	10315-508-000	. Integrated Ckt, U2, 3, 9		3
	154280-2	10318-508-000	. Integrated Ckt, U7, 10, 16		3
	154310-7	10321-508-000	. Integrated Ckt, U1, 4, 15		3
	168720-1	10331-508-000	. Integrated Ckt, U8, 11, 13		3
	300860-4	20451-512-000	. Printed Board		1

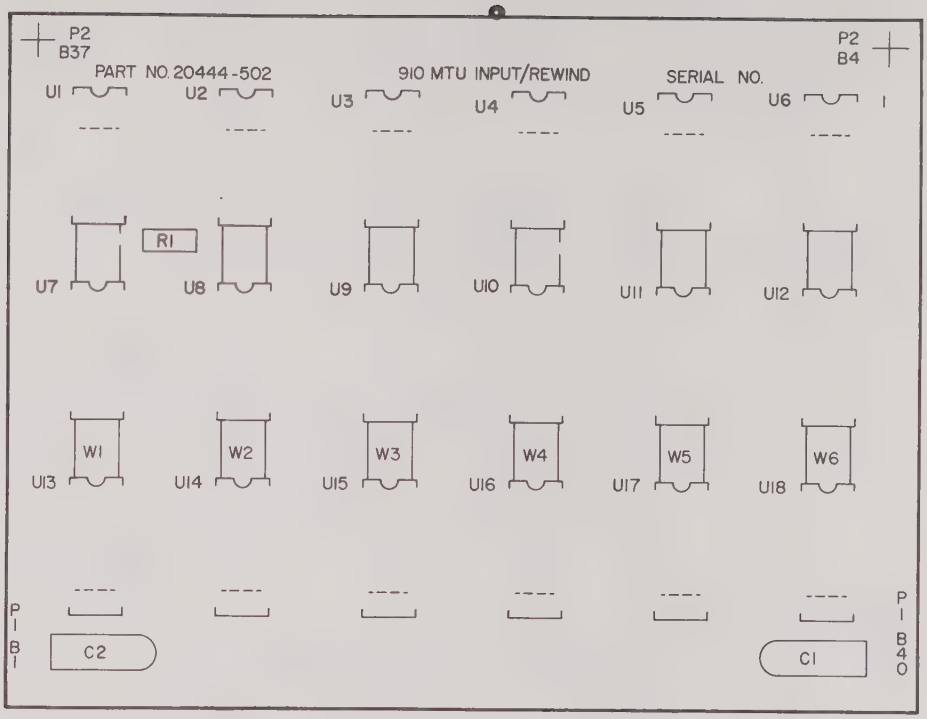

Figure 9-23. Assembly, 910 MTU INPUT/REWIND

Figure/ Item No.	I.C. Number	Part Number	Description	Rev. Ltr.	Qty Per Assy.
23-	298970-5	20444-502-000	Assy - 910 MTU Input/Rewind (see Figure 6-2 for NHA)	1	1
	253810-6	20104-405-001	. Bus Bar, 14 Pin, Dip, W1, 2, 3, 4, 5, 6		6
	079540-1	10212-504-400	. Resistor, 1K Ohm, ±5%, 1/4W, R1		1
	127740-9	10202-505-328	. Capacitor, 39 μf, ±10%, 10V, C1, C2		2
	150280-6	10307-508-000	. Integrated Ckt, Nand, Quad, U3, 10, 12		3
	111440-4	10310-508-000	. Integrated Ckt, Bus Driver-Triple, U8, 9, 13, 14, 15		5
	154230-7	10315-508-000	. Integrated Ckt, Flip-Flop, Dual, U1		1
	154280-2	10318-508-000	. Integrated Ckt, Nand, Dual, U2, 17		2
	154310-7	10321-508-000	. Integrated Ckt, Nand, Triple, U11, 18		2
	168720-1	10331-508-000	. Integrated Ckt, Nand, Hex, U4, 7, 16		3
	299580-1	20444-512-000	. Printed Board		1

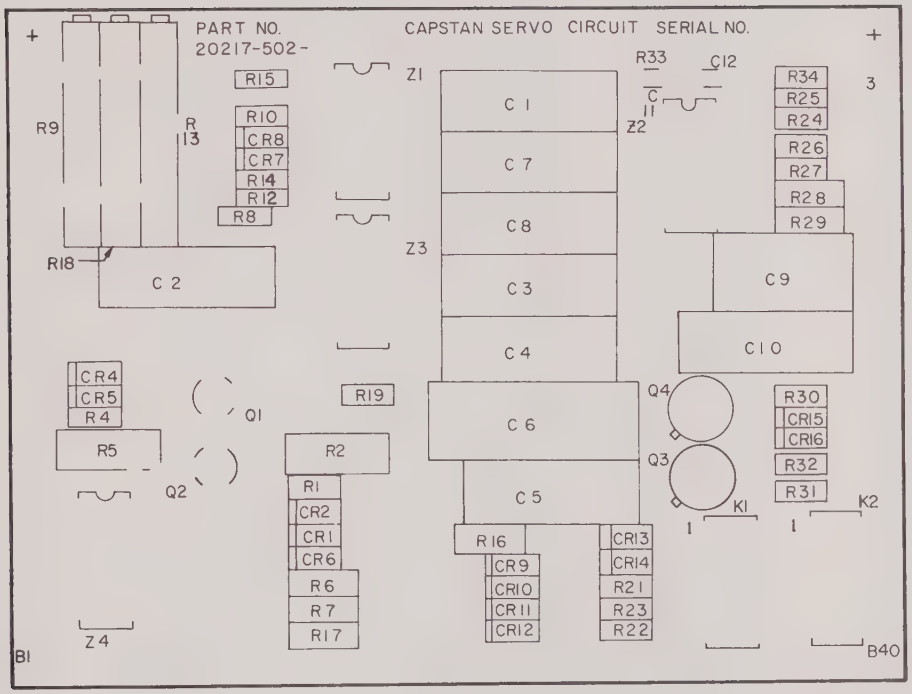

Figure 9-24. Assembly, Capstan Servo Circuit

Figure/ Item No.	I.C. Number	Part Number	Description	Rev. Ltr.	Qty. Per Assy.
24-	216150-3	20217-502-000	Assy - Capstan Servo Circuit (see Figure 6-2 for NHA)	6	1
	082250-2	10231-504-375	. Resistor, 330 Ohm, ±5%, 1W, R2, 5		2
	244250-7	10211-504-400	. Resistor, 1K Ohm, ±1%, 1/4W, R6, 7		2
	244270-5	10211-504-436	. Resistor, 5.62K Ohm, ±1%, 1/4W, R29		1
	131140-6	10212-504-458	. Resistor, 15K Ohm, ±5%, 1/4W, R24		1
	244260-6	10211-504-466	. Resistor, 22.1K Ohm, ±1%, 1/4W, R16, 17		2
	109120-6	10212-504-478	. Resistor, 39K Ohm, ±5%, 1/4W, R26		1
	110350-6	10211-504-536	. Resistor, 562K Ohm, ±1%, 1/4W, R28		1
	116510-9	10212-504-316	. Resistor, 22 Ohm, ±5%, 1/4W, R27		1
	116540-6	10212-504-325	. Resistor, 33 Ohm, ±5%, 1/4W, R30		1
	079500-5	10212-504-350	. Resistor, 100 Ohm, ±5%, 1/4W, R31, 32, 10		3
	079700-1	40203-504-414	. Resistor, Pot., 2K Ohm, 3/4W, R9		1
	109000-0	10212-504-404	. Resistor, 1.2K Ohm, ±5%, 1/4W, R22		1
	108980-4	10212-504-362	. Resistor, 180 Ohm, ±5%, 1/4W, R23		1
	109140-4	10212-504-428	. Resistor, 3.9K Ohm, ±5%, 1/4W, R25		1
	109180-0	10212-504-432	. Resistor, 4.7K Ohm, ±5%, 1/4W, R1, 4, 14, 21		4
	079610-2	10212-504-436	. Resistor, 5.6K Ohm, ±5%, 1/4W, R9		1
	079630-0	10212-504-450	. Resistor, 10K Ohm, ±5%, 1/4W, R8		1
	108900-2	10212-504-500	. Resistor, 100K Ohm, ±5%, 1/4W, R15		1
	243270-6	10611-504-550	. Resistor, 1M Ohm, ±5%, 1/4W, R12		1
	003170-8	40203-504-434	. Resistor, Pot., 5K Ohm, 3/4W, R18		1
	003190-6	40203-504-450	. Resistor, Pot., 10K Ohm, 3/4W, R13		1
	239830-3	10503-505-508	. Capacitor, 0.15 μf, ±10%, 50V, C11, 12		2
	000190-9	10401-505-394	. Capacitor, 820 pf, ±5%, 100V, C9		1
	243880-2	10317-505-250	. Capacitor, 1 μf, ±10%, 200V, C6		1
	000410-1	10311-505-200	. Capacitor, 0.1 μf, ±10%, 100V, C1, 2, 3, 4, 7, 8		6
	000430-9	10311-505-208	. Capacitor, 0.15 μf, ±10%, 100V, C10		1
	224360-8	10212-504-300	. Resistor, 10 Ohm, ±5%, 1/4W, R33, 34		2
	033690-9	10201-506-000	. Diode, CR1, 2, 4, 5, & 7 thru 16		14
	090440-9	40111-506-288	. Diode, CR6		1
	166260-0	12012-206-001	. Tstr Mount, Ref. Q4		3
	227630-1	10308-507-000	. Transistor, Q3		1
	080000-3	10407-507-000	. Transistor, Q1		1
	227620-2	10409-507-000	. Transistor, Q4		1
	003840-6	10304-507-000	. Transistor, Q2		1
	150280-6	10307-508-000	. Integrated Ckt, Z4		1
	193720-0	30304-508-000	. Integrated Ckt, Z1, 2, 3		3
	143890-1	20408-304-001	. Relay, K1, K2		2
	216160-2	20217-512-000	. Printed Board		1

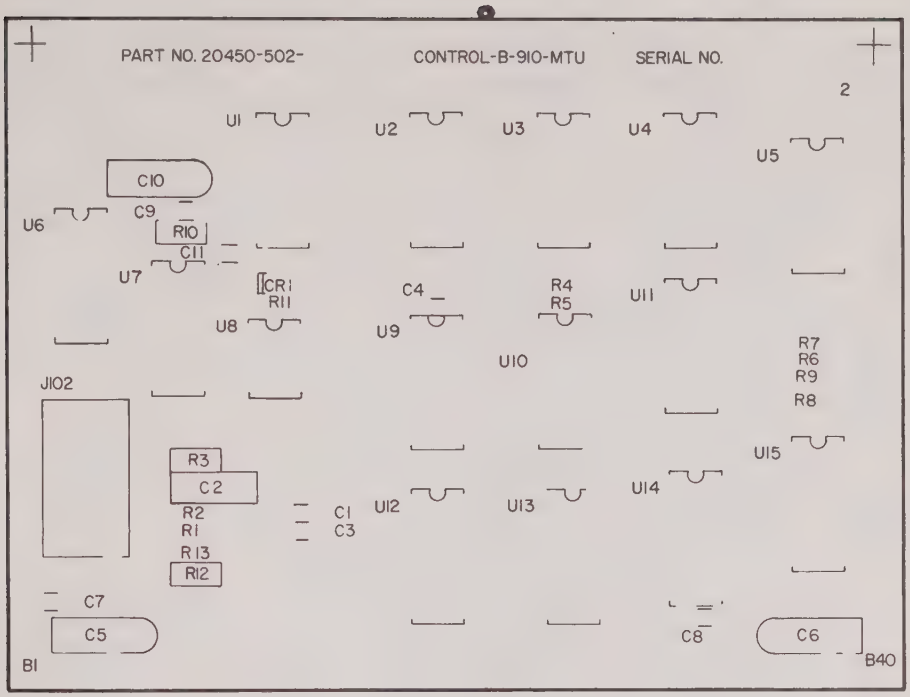

Figure 9-25. Assembly, Control-B-910-MTU

Figure/ Item No.	I.C. Number	Part Number	Description	Rev. Ltr.	Qty. Per Assy.
25-	300790-3	20450-502-000	Assy - Control - B - 910 - MTU (see Figure 6-2 for NHA)	4	1
	224360-8	10212-504-300	. Resistor, 10 Ohm, ±5%, 1/4W, R5		1
	079580-7	10212-504-416	. Resistor, 2.2K Ohm, ±5%, 1/4W, R3, 4, 6, 7, 8, 9, 10		7
	109120-6	10212-504-478	. Resistor, 39K Ohm, ±5%, 1/4W, R11		1
	140910-1	10212-504-512	. Resistor, 180K Ohm, ±5%, 1/4W, R2		1
	109180-0	10212-504-432	. Resistor, 4.7K Ohm, ±5%, 1/4W, R1		1
	079630-0	10212-504-450	. Resistor, 10K Ohm, ±5%, 1/4W, R12, 13		2
	127740-9	10202-505-328	. Capacitor, 39 μf, ±10%, 10V, C5, 6, 10		3
	226070-1	10503-505-500	. Capacitor, 0.1 μf, ±10%, 100V, C1, 3, 7, 8, 9		5
	239830-3	10503-505-508	. Capacitor, 0.15 μf, ±10%, 50V, C4		1
	000060-4	10401-505-316	. Capacitor, 22 pf, ±5%, 500V, C2		1
	226370-5	10502-505-450	. Capacitor, 0.01 μf, ±10%, 100V, C11		1
	033690-9	10201-506-000	. Diode, SI, 45V, 200 MA, CR1		1
	141870-6	10306-508-000	. Integrated Ckt, One Shot, U7		1
	286150-8	10364-508-000	. Integrated Ckt, Dual Flip-Flop, U11, 14		2
	286160-7	10365-508-000	. Integrated Ckt, Nand, Quad 2 Input, U5, 6, 12		3
	286210-0	10370-508-000	. Integrated Ckt, Inverter Hex, U10, 15		2
	286230-8	10372-508-000	. Integrated Ckt, Nand, Triple Input, U1, 13		2
	286300-9	10379-508-000	. Integrated Ckt, Nand, Dual 4 Input, U2, 3, 4, 9		4
	256820-2	30306-508-000	. Integrated Ckt, Operational Amp, U8		1
	300800-0	20450-512-000	. Printed Board		1
	325210-3	50015-404-001	. I.C. Socket, J102		1

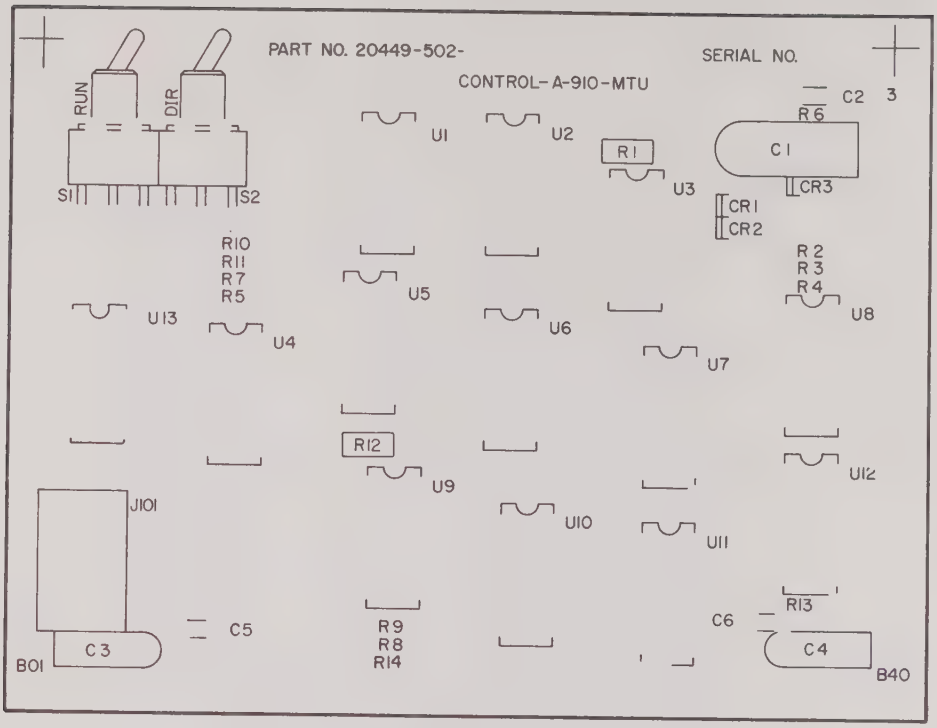

Figure 9-26. Assembly, Control-A-910-MTU, J18

Figure/ Item No.	I.C. Number	Part Number	Description	Rev. Ltr.	Qty Per Assy.
26-	300740-8	20449-502-000	Control-A-910-MTU, J18 (see Figure 6-2 for NHA)		1
	245950-1	10112-304-001	. Switch Toggle, SPDT, S1, S2		2
	204620-9	50009-404-001	. I.C. Socket, 14 Pin Dip, Ref. J101		1
	079580-7	10212-504-416	. Resistor, 2.2K Ohm, ±5%, 1/4W, R2, 3, 4, 8, 9, 10,11, 12, 13, 14		10
	079600-3	10212-504-425	. Resistor, 3.3K Ohm, ±5%, 1/4W, R1, 5, 7		3
	109120-6	10212-504-478	. Resistor, 39K Ohm, ±5%, 1/4W, R6		1
	127740-9	10202-505-328	. Capacitor, 39 μf, ±10%, 10V, 03, 4		2
	263040-6	10203-505-325	. Capacitor, 33 μf, ±10%, 15V, 41		1
	226070-1	10503-505-500	. Capacitor, 0.1μf, ±10%, 100V, 02, 5, 6		3
	033690-9	10201-506-000	. Diode, SI, 45V, 200MA, CR1, 2, 3		3
	141870-6	10308-508-000	. Integrated Ckt, One Shot, U8		1
	286150-8	10364-508-000	. Integrated Ckt, Flip-Flop, Dual, U7, 11		2
	286160-7	10365-508-000	. Integrated Ckt, Nand, Quad, 2 In., U5, 6, 10, 13		4
	286210-0	10370-508-000	. Integrated Ckt, Inverter, Hex, U4, 9		2
	286300-9	10379-508-000	. Integrated Ckt, Buffer, Nand, U12		1
	236230-8	10372-508-000	. Integrated Ckt, Nand Triple 3 In, U1, 2, 3		3
	300750-7	20449-512-000	. Printed Board		1

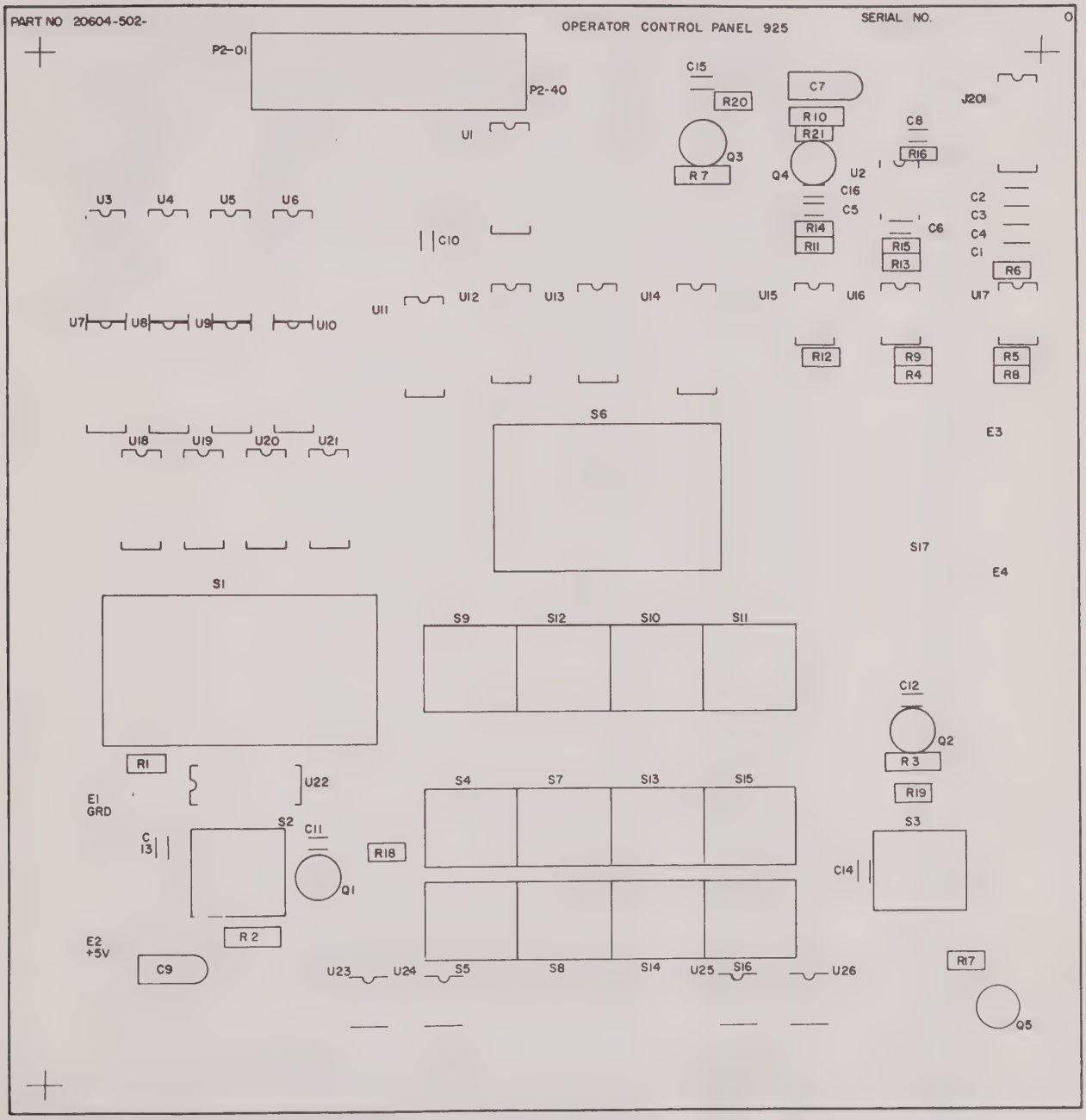

Figure 9-27. Assembly, Operator Control Panel

Figure/ Item No.	I.C. Number	Part Number	Description	Rev. Ltr.	Qty. Per Assy.
27-	372350-9	20604-502-000	Assy - Operator Control Panel (see Figure 6-2 for NHA)	4	1
	372360-8	21305-203-000	. Panel, Operator Control		1
	329940-1	11545-206-001	. Tab, Fast On		2
	072840-2	60005-206-167	. Screw, Flat Head 100°, 4-40 x 2/8		9
	029510-5	60010-206-166	. Screw, Fan Head, 4-40 x 5/16		13
	368170-7	72036-206-003	. Stand Off, Round, 4-40 x 3/16		2
	372540-5	72036-206-006	. Stand Off, Round, 4-40 x 3/5		4
	357210-4	72036-206-007	. Stand Off, Round, 4-40 x 7/16		5
	149140-6	74002-206-071	. Washer, Flat #4		11
	030060-8	74007-206-071	. Washer, Split Lock #4		11
	076570-1	40002-206-018	. Eyelet, SE46		2
	314230-4	10206-303-001	. Read Out, Num, Led, Red, U18 – 21		4
	369730-7	10014-304-001	. Switch, Rocker SPDT, S17		1
	353410-4	10500-304-001	. Switch, PB Mom, Solst., S2 – 5, 7 – 16		14
	369710-9	11306-304-001	. Switch, Thbwheel Mess., S6		1
	369700-0	11207-304-001	. Switch, Thumbwheel, BCD, S1		1
	374220-2	80951-404-001	. Fastener, Dip Lock, Ref. J201		1
	369790-1	20366-401-208	. Cable Assy, IC Intercon, 14 Pin, Ref. J201		1
	374200-4	50022-404-001	. Socket, Dip, 14 Pin, J201		1
	322000-1	30031-404-001	. Connector, PCB to Flat Cbl, Ref. P2		1
	369680-4	30039-404-001	. Connector, Transition		1
	204620-9	50009-404-001	. Socket, IC Wire Wrap, 14 Pin, Ref. U18-21		4
	205940-0	80306-404-002	. Contact, Male, 22 AWG		2
	274550-3	80309-404-001	. Housing, Plug, 2 Cond, P1		1
	355780-8	50009-404-002	. Socket, IC, W/W, 14 Pin, Ref. U18-21		4
	221080-5	10201-405-140	. Wire, PVC, 22 AWG, Wht		1 ft.
	322010-0	30406-405-001	. Cable, Flat, PV2, 28 AWG, 40 Cond		2 ft.
	079540-1	10212-504-400	. Resistor, 1K Ohm, ±5%, 1/4W, R18-21		4
	116540-6	10212-504-325	. Resistor, 33 Ohm, ±5%, 1/4W, R4, 5, 6, 15, 16		5
	079530-2	10212-504-390	. Resistor, 680 Ohm, ±5%, 1/4W, R17		1
	109180-0	10212-504-432	. Resistor, 4.7K Ohm, ±5%, 1/4W, R1, 8, 9, 11, 12, 13		6
	002380-4	10222-504-350	. Resistor, 100 Ohm, ±5%, 1/2W, R2, 3, 7, 10		4
	359690-5	60104-504-366	. Resistor Net., 220 Ohm, ±2%, U7, 8, 9, 10		4
	368780-3	60106-504-432	. Resistor Net., 4.7K Ohm, ±2%, U14, 22		2
	224360-8	10212-504-300	. Resistor, 10 Ohm, ±5%, 1/4W, R14		1
	127740-9	10202-505-328	. Capacitor, 39 μf, ±10%, 10V, C7, 9		2
	303450-1	10507-505-190	. Capacitor, 0.068 μf, +50 -20%, 25V, C1 – 6, 8, 10 – 16		14
	003810-9	10404-507-000	. Transistor, 2N3566, Q1 – 4		4
	003840-6	10304-507-000	. Transistor, 2N3645, Q5		1
	270450-0	10362-508-000	. Integrated Ckt, SN75451P, U2, 15 – 17, 23 – 26		8
	286210-0	10370-508-000	. Integrated Ckt, SN7404, U11		1
	286230-8	10372-508-000	. Integrated Ckt, SN7410, U12, 13		2
	286330-6	10382-508-000	. Integrated Ckt, SN7442, U1		1
	314250-2	10402-508-000	. Integrated Ckt, SN7447, U3 – 6		4
	372370-7	20604-512-000	. Printed Board		1
	372420-0	11615-304-101	. Button, Switch, 2SW611AL, Ref. S2 (Exec)		1
	372430-9	11615-304-102	. Button, Switch, 2SW611AL, Ref. S3 (Prog. Load)		1
	372440-8	11615-304-103	. Button, Switch, 2SW611AL, Ref. S4 (Stop, 0)		1
	372380-6	11615-304-004	. Button, Switch, 2SW611AL, Ref. S5 (4)		1
	372450-7	11615-304-104	. Button, Switch, 2SW611AL, Ref. S7 (Srch, 1)		1

Figure/ Item No.	I.C. Number	Part Number	Description	Rev. Ltr.	Qty. Per Assy.
27-	372390-5	11615-304-005	. Button, Switch, 2SW611AL, Ref. S8 (5)		1
	372460-6	11615-304-105	. Button, Switch, 2SW611AL, Ref. S9 (Tape Load)		1
	372470-5	11615-304-106	. Button, Switch, 2SW611AL, Ref. S10 (Rewd)		1
	372480-4	11615-304-107	. Button, Switch, 2SW611AL, Ref. S11 (Rset)		1
	372490-3	11615-304-108	. Button, Switch, 2SW611AL, Ref. S12 (Bot)		1
	372500-9	11615-304-109	. Button, Switch, 2SW611AL, Ref. S13 (Sngl, Plot, 2)		1
	372400-2	11615-304-006	. Button, Switch, 2SW611AL, Ref. S14 (6)		1
	372510-8	11615-304-110	. Button, Switch, 2SW611AL, Ref. S15 (Mult, Plot, 3)		1
	372410-1	11615-304-007	. Button, Switch, 2SW611AL, Ref. S16 (7)		1

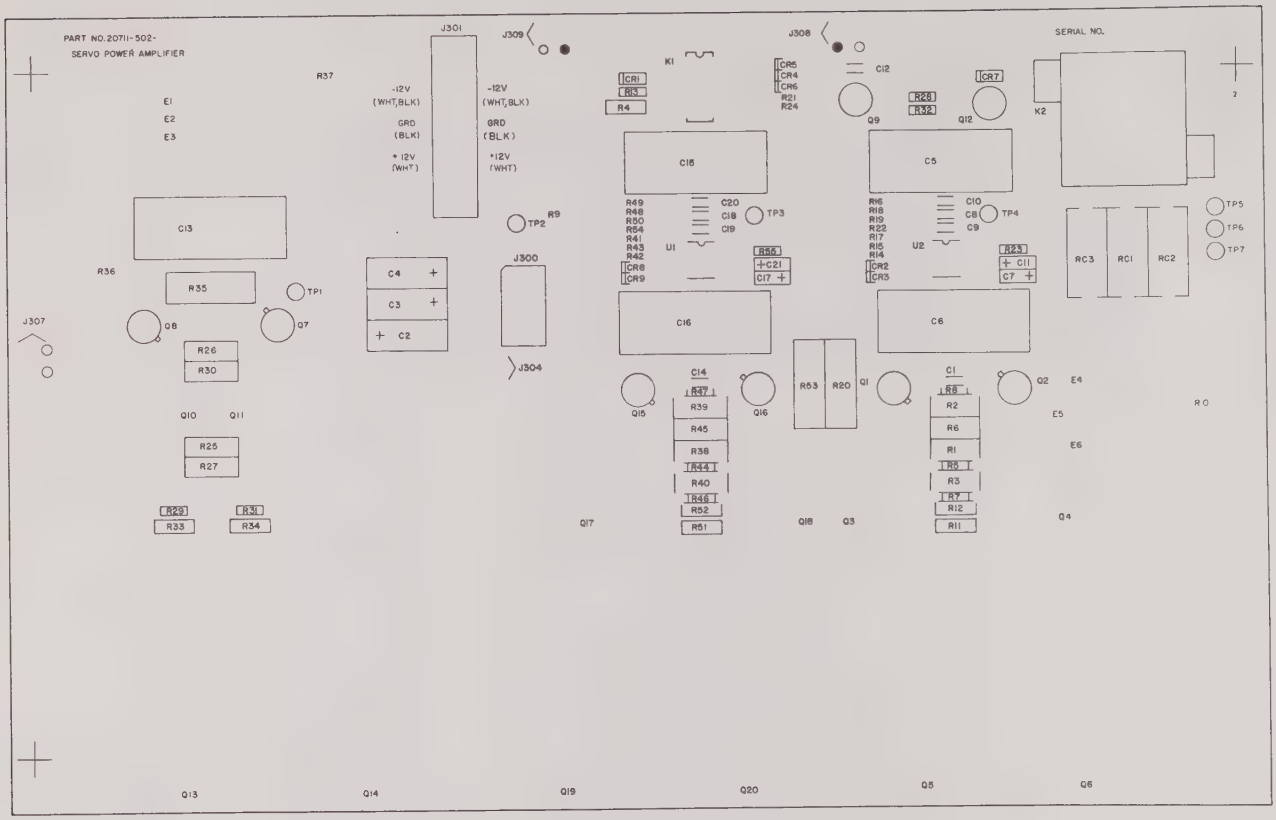

Figure 9-28. Assembly, Servo Power Amplifier

Figure/ Item No.	I.C. Number	Part Number	Description	Rev. Ltr.	Qty. Per Assy.
28-	399800-2	20711-502-000	Assy - Servo Power Amplifier (see Figure 6-3 for NHA)	2	1
	405210-6	10525-306-000	. Dissipator, Heat Sink - MTU		1
	329940-1	11545-206-001	. Terminal, Tab, Fast On, Ref. (TB01)		3
	166260-0	12012-206-001	. Mount, Transistor, T05, Ref. (Q1, 2, 7, 8, 9, 12, 15, 16)		8
	329920-3	13054-206-003	. Terminal Block, TB01		1
	064620-8	13505-206-001	. Test Jack, Vertical, Brn, TP1		1
	064580-4	13505-206-002	. Test Jack, Vertical, Red, TP2		1
	064600-0	13505-206-003	. Test Jack, Vertical, Org, TP3		1
	064610-9	13505-206-004	. Test Jack, Vertical, Yel, TP4		1
	272160-3	13505-206-005	. Test Jack, Vertical, Grn, TP5		1
	247400-5	13505-206-006	. Test Jack, Vertical, Blue, TP6		1
	344270-4	13505-206-007	. Test Jack, Vertical, Vio, TP7		1
	245250-6	12009-206-001	. Insulator, Mica		6
	173620-6	50001-206-012	. Nut, Hex, 6-32		16
	029630-3	60010-206-168	. Screw, Pan Hd, 6-32 x 7/16		2
	029640-0	60010-206-249	. Screw, Pan Hd, 6-32 x 1/2		12
	326390-2	73034-206-001	. Hld Dwn Spring, Ref. (K1)		1

Figure/ Item No.	I.C. Number	Part Number	Description	Rev. Ltr.	Qty. Per Assy.
28-	149140-6	74002-206-071	. Washer, Flat #4		2
	029310-0	74002-206-113	. Washer, Flat #6		16
	030060-8	74007-206-071	. Washer, Split Lock #4		2
	030010-3	74008-206-111	. Washer, Int. Tooth #6		16
	397230-4	12536-206-000	. Socket, Comp. Lead, Ref. (Q5, 6, 13, 14, 19, 20)		12
	029510-5	60010-206-160	. Screw, Pan Hd, 4-40 x 5/16		2
	326340-7	10613-304-001	. Switch, SPDT, Min, Roller, S1, 2		2
	326370-4	20118-304-001	. Relay, 24 VDC, 10A, 11 Pin, K2		1
	243890-1	20406-304-001	. Relay, 5 VDC, 5A, Form A, K1		1
	326380-3	50016-404-001	. Socket, Relay, 11 Cont, Ref. K2		1
	361660-4	50018-404-002	. Socket, IC, 8 Pin, Ref. U1, 2		2
	374210-3	50023-404-001	. Socket, IC, 16 Pin, J300		1
	218420-8	80349-404-001	. Contact, Male PCB, Ref. (J304, J308, J309)		3
	218410-9	80350-404-001	. Contact, Female PCB, Ref. (J304, J307, J308, J309)		7
	374230-1	60951-404-002	. Clip, Dip Lock, 16 Pin, Ref. (J300)		1
	171900-4	60010-206-250	. Screw, Pan Hd, 6-32 x 5/8		2
	108980-4	10212-504-362	. Resistor, 180 Ohm, ±5%, 1/4W, R8, 47		2
	173410-2	10212-504-386	. Resistor, 560 Ohm, ±5%, 1/4W, R15, 43		2
	109000-0	10212-504-404	. Resistor, 1.2K Ohm, ±5%, 1/4W, R5, 7, 29, 31, 44, 46		6
	079580-7	10212-504-416	. Resistor, 2.2K Ohm, ±5%, 1/4W, R13		1
	079600-3	10212-504-425	. Resistor, 3.3K Ohm, ±5%, 1/4W, R22, 23, 28, 32, 54, 55		6
	109180-0	10212-504-432	. Resistor, 4.7K Ohm, ±5%, 1/4W, R17, 21, 41		5
	131140-6	10212-504-458	. Resistor, 15K Ohm, ±5%, 1/4W, R14, 24, 42		3
	109050-5	10212-504-466	. Resistor, 22K Ohm, ±5%, 1/4W, R16, 19, 49, 50		4
	109160-2	10212-504-482	. Resistor, 47K Ohm, ±5%, 1/4W, R18, 48		2
	002330-9	10222-504-332	. Resistor, 47 Ohm, ±5%, 1/2W, R11, 12, 33, 34, 51, 52		6
	002380-4	10222-504-350	. Resistor, 100 Ohm, ±5%, 1/2W, R4		1
	002830-8	10231-504-350	. Resistor, 100 Ohm, ±5%, 1W, R1, 3, 25, 27, 38, 40		6
	131070-5	10231-504-366	. Resistor, 220 Ohm, ±5%, 1W, R2, 26, 30, 39		4
	002870-4	10231-504-386	. Resistor, 560 Ohm, ±5%, 1W, R6, 45		2
	234950-4	10523-504-234	. Resistor, 0.5 Ohm, ±3%, 5W, R20, 35, 53		3
	326350-6	40209-504-450	. Potentiometer, 10K Ohm, 1/2W, R9, 36		2
	405420-1	10503-505-000	. Capacitor, Select at Test, C10, 20		2
	000590-0	10205-505-200	. Capacitor, 0.1 μf, ±10%, 35V, C7, 11, 17, 21		4
	265650-2	10205-505-328	. Capacitor, 39 μf, ±10%, 35V, C2, 3, 4		3
	395960-8	10310-505-264	. Capacitor, 2 μf, ±10%, 50V, C5, 15		2
	186960-1	10317-505-284	. Capacitor, 5 μf, ±10%, 200V, C6, 13, 16		3
	033370-8	10502-505-394	. Capacitor, 820 pf, ±10%, 200V, C9, 19		2
	313040-8	10503-505-475	. Capacitor, 0.033 μf, ±10%, 100V, C1, 14		2
	226070-1	10503-505-500	. Capacitor, 0.1 μf, ±10%, 100V, C8, 18		2
	258090-0	10503-505-525	. Capacitor, 0.33 μf, ±10%, 50V, C12		1
	033690-9	10201-506-000	. Diode, 1N914, CR1 – 6, 8, 9		8
	068890-3	20101-506-334	. Diode, 1N4001, CR7		1
	003840-6	10304-507-000	. Transistor, 2N3645, Q12		1
	227630-1	10308-507-000	. Transistor, 2N4037, Q2, 8, 16		3

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